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U.S. DEPARTMENT OF ENERGY
Hanford Waste Vitrification Plant
Richland, Washington
DOE Contract DE-AC06-86RL10838

FLUOR DANIEL, INC.
Advanced Technology Division
Fluor Contract 8457

SECTION 15010
HVAC BASIC REQUIREMENTS
B-595-C-E350-15010

APPROVED FOR CONSTRUCTION

REVISION 1 PER CR-0859
ISSUE DATE 6/4/93

WAPA YES ___ NO X
QUALITY LEVEL I ___ II X
SAFETY CLASS 1__ 2__ 3 X 4__

ORIGINATOR:

B. Entezam, HVAC Engineer — 07/08/93 Date

CHECKER:

R. E. Flye, HVAC Engineer — 7.8.93 Date

APPROVED BY:

M. G. Mercado Lead Discipline Engineer — Date 7/14/93

SECTION 15010
HVAC BASIC REQUIREMENTS
B-595-C-E350-15010

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SECTION 15010
HVAC BASIC REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

1.1.1 This section summarizes the scope of work by the Seller that pertains to all works required under heating, ventilating and air conditioning (HVAC) system applicable to the Canister Storage Building. This section also provides the basic requirements for submittal, labeling, packaging, and installation/construction of miscellaneous items and equipment related to HVAC system.

1.1.2 The work shall be for a complete system. Seller shall furnish all labor, supervision, materials and equipment necessary for the installation, testing, start-up and placing into operation the air conditioning, heating and ventilating system as specified herein and as shown on the Contract Drawings. The work shall include but not be limited to the following:

1.1.2.1 Furnishing, and installation of HVAC equipment and materials, and shall include as follows:

A. Vibration isolation devices as provided in accordance with Specification Section 15200.

B. Thermal insulation as provided in accordance with Specification Section 15258.

C. Unit electric heaters as provided in accordance with Specification Section 15760.

D. Air conditioning units and associated refrigerant piping as provided in accordance with Specification Section 15771.

E. Air handling units (evaporative cooler type) as provided in accordance with Specification Section 15782.

F. Miscellaneous fans as provided in accordance with Specification Section 15832.

G. Electric duct heaters as provided in accordance with Specification Section 15836.

H. Ductwork as provided in accordance with Specification Section 15840.

I. Dampers as provided in accordance with Specification Section 15861.

J. Air distribution devices as provided in accordance with Specification Section 15870.

K. Air filters as provided in accordance with Specification Section 15883.

L. Air intake hoods as provided in accordance with Specification Section 15878.

1.1.2.2 HVAC system testing and balancing work as provided in accordance with Specification Section 15990.

1.1.2.3 Furnishing, and installation of associated HVAC miscellaneous items of works and materials as shown on the Contract Drawings and shall include, but not be limited to the following:

A. HVAC system controls and instrumentation in accordance with Specification Sections 17601, 17605, 17612, 17612W, 17614W, 17630, 17630W, 17669, 17696, 17697, 17703, 17704, 17705, 17708, 17864, and associated electrical works in accordance with Specification Sections 16100, 16110 and 16610.

B. Equipment concrete pads or foundations in accordance with Specification Section 03300.

C. All HVAC service connections and materials for piping (except for refrigerant piping), valves, fittings, and miscellaneous related items shall be in accordance with Specification Section 15061, and as shown on piping Contract Drawings.

D. Structural steel supports for equipment, ductwork, and piping in accordance with Specification Section 05120, and as shown on Contract Drawings.

E. Openings and required flashing for pipes and ducts in accordance with Specification Section 07600.

F. Painting in accordance with Specification Section 09900.

G. Welding in accordance with Specification Section 05067.

H. Motors in accordance with Specification Section 16150.

1.1.3 Codes Compliance

All work and equipment provided in the scope of this package shall be installed in strict accordance with applicable federal, state, and local codes, ordinances, rules and regulations of public administrative including all health and safety codes, pollution control, Occupational Safety and Health Administration (OSHA) and

the applicable sections of the Code of Federal Regulations (CFR) requirements. The seller shall obtain necessary permit/approval of the system from the authority having jurisdiction before starting work.

1.2 **REFERENCES**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	1989 Standard for the Installation of Air Conditioning and Ventilating Systems
NFPA 70	1990 National Electrical Code

1.3 **RELATED REQUIREMENTS**

Specification Section 03300	Cast-In-Place Concrete
Specification Section 05067	Welding HVAC Systems
Specification Section 05120	Structural Steel
Specification Section 07130	Operation and Maintenance Data
Specification Section 07600	Flashing and Sheet Metal
Specification Section 09900	Painting
Specification Section 15061	Piping Material, Fabrication, Erection and Pressure Testing (Carbon Steel, Iron and Nonmetallic)
Specification Section 15196	Identification and Tagging Methods for Mechanical Equipment
Specification Section 15200	Vibration Isolation Devices
Specification Section 15258	Thermal Insulation for Ductwork and Piping
Specification Section 15760	Unit Heaters - Electric
Specification Section 15771	Air Conditioning Units
Specification Section 15782	Air Handling Units (Evaporative Cooler Type)

Specification Section 15832	Miscellaneous Fans (HVAC)
Specification Section 15836	Electric Duct Heaters
Specification Section 15840	Ductwork
Specification Section 15861	Dampers
Specification Section 15870	Air Distribution Devices
Specification Section 15878	Air Intake Hoods
Specification Section 15883	Air Filters (HVAC)
Specification Section 15990	HVAC System Testing and Balancing
Specification Section 16100	Electrical Installation
Specification Section 16110	Electrical Materials and Devices
Specification Section 16150	Motors-Induction
Specification Section 16610	Electrical Requirements for Packaged Equipment
Specification Section 17601	Temperature Transmitters - Electronic
Specification Section 17605	Room Thermostats - Electronic
Specification Section 17612	Thermowells and Resistance Temperature Detectors
Specification Section 17612W	Thermowells and Resistance Temperature Detectors
Specification Section 17614W	Thermowells and Resistance Temperature Detectors Canister Storage Building Vault
Specification Section 17630	Mass Flowmeters
Specification Section 17630W	Mass Flowmeters
Specification Section 17669	Flow Switches
Specification Section 17696	Humidity Transmitters - Electronic
Specification Section 17697	Duct Type Smoke Detectors
Specification Section 17703	Instrument Piping Materials

Specification Section 17704	General Instrumentation Installation and Testing
Specification Section 17705	Instrument Calibration and Checkout
Specification Section 17708	Instrument Piping Pressure Testing
Specification Section 17864	Instruments Furnished with Mechanical Equipment Canister Storage Building

1.4 **DEFINITIONS**

(Not Used)

1.5 **SYSTEM DESCRIPTION**

(Not Used)

1.6 **SUBMITTALS**

Submit the following in accordance with the Vendor Drawing and Data Requirements section of the Order/Subcontract. Refer to each particular piece of equipment and material specification section for these requirements in detail.

1.6.1 Equipment Product Literatures.

1.6.2 Equipment Dimensional Outline Drawings.

1.6.3 Equipment and Materials Performance Data.

1.6.4 Equipment and Materials Parts List and Spare Parts List.

1.6.5 Equipment Installation, Operating, and Maintenance Instructions.

1.6.6 Equipment and Materials Installation/Construction Inspection and Checkout List.

1.6.7 Factory Acceptance Tests (FATs) Reports.

1.6.8 Construction Acceptance Tests (CATs) Reports,

1.6.9 As-Built Drawings.

1.6.10 Manuals - Upon completion of works, the Seller shall prepare and submit to the Buyer six (6) copies of the manuals containing all the data and information in Paragraphs 1.6.1, 1.6.2, 1.6.3, 1.6.4, 1.6.5, 1.6.6, 1.6.7, 1.6.8 and 1.6.9 of this specification.

1.7 CLASSIFICATION OF SYSTEM AND COMPONENTS

(Not Used)

1.8 PROJECT OR SITE ENVIRONMENTAL CONDITIONS

1.8.1 Climatic and Geographic Site Conditions

A. Site Elevation 714 feet above sea level

B. Barometric Pressure 14.3 psia

C. Outside Design Temperature

1) Summer Design Temperature 101°F

2) Winter Design Temperature 9°F

3) Wet-Bulb Design Temperature 68°F

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 General

2.1.1.1 Specification of certain equipment and materials by brand name is intended to establish a standard of quality.

2.1.1.2 Substitutions for an item(s) described in the contract documents shall be as follows:

A. Where "Equal" is included for an item, product, material, system, or equipment; a substitution shall be allowed only if written approval by the Buyer is obtained. Proposed substitution shall be:

1) Provided with certified data as required in the Specifications and Contract Drawings.

2) Available in quantity sufficient to prevent delay of the work.

3) Provided in same range of colors, textures, gauges, dimensions, capacities, functions, types and finishes.

4) Equal to specified item in strength, durability, efficiency, serviceability, ease and cost of maintenance.

5) Compatible with the design and without additional cost to the Buyer.

2.1.1.3 All items and materials furnished by the Seller shall be the size, type and capacity specified on the Contract Drawings and/or on the specifications. Manufacturer of such furnished items and materials shall be a company specializing and regularly engaged in the manufacture of its product(s), who issues complete catalog data and documents field installed devices operating successfully.

2.2 **FABRICATION AND MANUFACTURE**

(Not Used)

2.3 **LABELING**

In addition to the manufacturer's identification nameplate, each piece of equipment shall be supplied with a corrosion-resistant metal identification tag in accordance with Specification Section 15196, Paragraph 2.2.2.9.

2.4 **PACKAGING**

Preparation for shipment and packing shall conform to the manufacturer's standards and shall provide protection against corrosion and handling. Preparation shall include the following:

2.4.1 Machined surfaces and threads shall be protected during shipment by application of grease or other suitable rust inhibiting compound.

2.4.2 Piping openings to equipment shall be protected to prevent damage during shipment and the openings shall be plugged or capped to prevent contamination.

2.4.3 Temporary bracing, supports, and rigging connections shall be provided as necessary to prevent damage during shipment, lifting, and unloading.

2.4.4 Separate or loose parts shall be completely boxed and attached to the main equipment and shipped as a unit. All shipping boxes shall be identified with the equipment number(s), Seller's purchase order number, description of the equipment, manufacturer's name, Seller's name, project identification, and destination with ink, paint, or other indelible material. A copy of the packing list shall be securely affixed to the outside of each package or crate.

PART 3 EXECUTION

3.1 PREPARATION

Before installation, Seller shall review all pertinent documentation and verify the following:

3.1.1 All documentation (data and drawings) required by Paragraph 1.6 of this specification has been submitted to the Buyer.

3.1.2 The Seller has received from the Buyer approved specifications and Contract Drawings covering all equipment, materials and accessories to be installed.

3.1.3 Inspect each piece of equipment to make sure that it is complete with all accessories as specified.

3.1.4 Inspect the foundation or pad on which the equipment and/or devices will be installed to make sure it is of the size required.

3.1.5 Verify that the components or equipment carry the required certifications as called for in the specifications.

3.1.6 All the necessary permit/approval for the system are in order.

3.2 INSTALLATION, APPLICATION AND ERECTION

3.2.1 General

3.2.1.1 The installation of heating, ventilating and air conditioning systems shall conform to NFPA 90A and NFPA 70, and as indicated on the Contract Drawings and specifications.

3.2.1.2 Install equipment and devices, and its accessories in accordance with the manufacturer's recommended installation instructions, and as indicated herein. Refer also to each particular piece of equipment specification for supplementary installation requirements.

3.2.1.3 Align, level and adjust all equipment for proper operation. Install equipment so that connecting and disconnecting of piping and accessories can readily be done and all parts are readily accessible for inspection, service and repair.

3.2.1.4 Provide all service utilities as indicated on the drawings including electrical, plumbing, and piping. Piping stubouts shall be capped to protect from the elements. All ducts and piping shall be capped in a manner suitable for future extension as shown on the Contract Drawings.

3.2.2 Verification of Dimensions

3.2.2.1 Scaled and figured dimensions as shown on the Contract Drawings are approximate. Before proceeding with the work, carefully check and verify dimensions at the site. Equipment and materials shall be properly fitted/attached to the structure in spaces provided.

3.2.2.2 Contract Drawings are diagrammatic and many offsets, bends, special fittings and exact locations may not be indicated. Contract Drawings and site locations shall be evaluated in order to identify exact locations, routes, building obstructions, and materials and equipment that can be installed in available locations to avoid obstructions, maintain headroom, and keep openings and passageway clear.

3.2.3 Painting

Prime coating and finish painting of non-galvanized sheet metal and steel surfaces, including touch-up painting of equipment which have been disturbed or damaged, shall be provided in accordance with Specification Section 09900.

3.2.4 Accessibility

Valves, dampers, thermostats, gauges, control devices or other miscellaneous items requiring reading, adjustment, inspection, repairs, removal or replacement shall be conveniently accessible throughout the finished building.

3.2.5 Provision For Later Installation

Where any work cannot be installed as the construction is progressing, provide boxes, sleeves, inserts, fixtures or devices as necessary to permit installation of the omitted work for later phases of construction. Chases, holes and other openings in masonry and concrete shall be arranged for placing equipment.

3.2.6 Equipment Final Connections

Provide all piping and duct final connections for all HVAC equipment as specified and as indicated on the Contract Drawings. Final connections shall be complete with necessary valves, drains, unions, flanges, etc. as indicated on the Contract Drawings.

3.3 **FIELD QUALITY CONTROL**

3.3.1 As-Built Drawings

3.3.1.1 During progress of the work, an accurate up-to-date record of all changes made to the air conditioning system due to equipment substitution or change of field routing shall be maintained.

3.3.1.2 A copy of as-built drawings shall be submitted to the Buyer at the completion of work.

3.4 **ADJUSTMENTS**

(Not Used)

3.5 **CLEANING**

Seller shall thoroughly clean all equipment before placing them in operation, restore to manufacturer's finished standard, if damaged, and deliver the entire installation in an approved condition.

3.6 **PROTECTION**

(Not Used)

3.7 **DEMONSTRATION**

The Seller shall provide, as necessary, the services of factory trained representative for each piece of equipment to provide instruction and demonstrate to the Buyer the proper procedure for starting and operating the equipment.

3.8 **SCHEDULES**

(Not Used)

END OF SECTION

U.S. DEPARTMENT OF ENERGY
Hanford Waste Vitrification Plant
Richland, Washington
DOE Contract DE-AC06-86RL10838

FLUOR DANIEL, INC.
Advanced Technology Division
Fluor Contract 8457

SECTION 15200
VIBRATION ISOLATION DEVICES
B-595-C-E350-15200

APPROVED FOR CONSTRUCTION

REVISION 1 PER CR-0859
ISSUE DATE 8/4/93

WAPA YES ___ NO X
QUALITY LEVEL I ___ II X
SAFETY CLASS 1__ 2__ 3 X 4__

ORIGINATOR:

Behzad Entezam 7/8/93
B. Entezam, HVAC Engineer Date

CHECKER:

R. E. Flye 7.8.93
R. E. Flye, HVAC Engineer Date

APPROVED BY:

Manuel G. Mercado 7/14/93
M. G. Mercado Lead Discipline Engineer Date

SECTION 15200
VIBRATION ISOLATION DEVICES
B-595-C-E350-15200

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ATTACHMENTS

SECTION 15200
VIBRATION ISOLATION DEVICES

PART 1 GENERAL

1.1 SUMMARY

This section defines the minimum technical requirements for furnishing, installing and checking out equipment vibration isolation devices for heating, ventilating and air conditioning system.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARD INSTITUTE, INC. (ANSI)

ANSI B1.1	1989 Unified Inch Screw Threads (UN and UNR Thread Form)
ANSI B18.2.1	1981 Square and Hex Bolts and Screws (Inch Series)
ANSI B18.21.1	1990 Lock Washers (Inch Series)
ANSI B18.22.1	1975 Plain Washers

AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND AIR-CONDITIONING ENGINEERS, INC. (ASHRAE)

ASHRAE Handbook	1987 ASHRAE Handbook HVAC Systems and Applications

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)/ AMERICAN NATIONAL STANDARD INSTITUTE, INC. (ANSI)

ANSI B18.2.2	1987 Square and Hex Nuts (Inch Series)

1.3 RELATED REQUIREMENTS

Specification Section 01730	Operation and Maintenance Data
Specification Section 05067	Welding HVAC Systems

1.4 **DEFINITIONS**

(Not Used)

1.5 **SYSTEM DESCRIPTION**

(Not Used)

1.6 **SUBMITTALS**

Submit the following in accordance with the Vendor Drawing and Data Requirements section of the Order/Subcontract.

1.6.1 Literature - Descriptive literature and catalog sheets with manufacturer's name, model number(s), shipping weight and operating weight.

1.6.2 Dimensional Outline Drawings - The drawings shall include:

A. Plan views and assembly drawings.

B. Sectional views showing internal arrangement of components.

C. Overall dimensions and interfacing dimensions.

D. Mounting hole locations and sizes.

E. Dimensional details for each component, magnitude of adjustment and method of removal.

1.6.3 Factory Acceptance Test (FAT) - Performance ratings of the vibration isolation devices shall include the isolator loading capacity, deflection, compressed height and solid height, spring rate, ratio of lateral to vertical stiffness, vertical and lateral natural frequencies, and isolation efficiency.

1.6.4 Parts List and Spare Parts List - A complete parts list and a list of manufacturer's recommended spare parts. Include sufficient information to permit procurement of parts from the manufacturer or any subsupplier.

1.6.5 Installation, Adjustment and Maintenance Instructions - Detailed installation, adjustment and maintenance instructions shall be submitted in accordance with Specification Section 01730, Operation and Maintenance Data. In addition, a copy of each shall be shipped with the equipment.

1.6.6 Inspection and Checkout List - The Seller shall prepare a checklist for the inspection and checkout of the vibration isolation devices using the format of Attachment A or other form that includes all the information requested in Attachment A. This

checklist shall be submitted to the Buyer and shall include the following as a minimum:

A. Verify that the isolators are installed in accordance with manufacturer's installation instructions, the Contract Drawings, and this specification.

B. Verify that the spring and brackets are aligned and can depress freely.

C. Check that isolators are secured in-place with anchor bolts.

1.6.7 Construction Acceptance Test (CAT) - Inspection and Testing per Paragraph 3.3.1 of this specification.

1.7 **CLASSIFICATION OF SYSTEM AND COMPONENTS**

(Not Used)

1.8 **PROJECT OR SITE ENVIRONMENTAL CONDITIONS**

(Not Used)

PART 2 PRODUCTS

2.1 **MATERIALS AND EQUIPMENT**

2.1.1 General

2.1.1.1 Vibration isolators shall be the spring mounting type or the neoprene mounting type as specified with the equipment, or as indicated on the Contract Drawings.

2.1.1.2 Attachment bolting shall be zinc or cadmium plated and shall be in accordance with ANSI Standards B1.1, B18.2.1, B18.2.2, B18.21.1 and B18.22.1.

2.1.1.3 All welding shall be in accordance with Specification Section 05067.

2.1.1.4 All vibration isolation devices shall have manufacturer's standard prime coat and finish.

2.1.2 Spring Mounting Type

2.1.2.1 Performance of spring mounting type vibration isolation devices shall be adequate for the associated rotating equipment. The following parameters shall be in accordance with the rotating equipment manufacturer's recommendations.

A. Load carrying capacity

B. Spring diameter

C. Compressed spring height

D. Solid spring height

E. Deflection

F. Spring rate

G. Ratio of lateral to vertical stiffness

H. Vertical and lateral natural frequencies

2.1.2.2 Spring type vibration isolators shall be of steel construction, free standing and laterally stable without any housing and complete with 1/4 inch minimum thickness neoprene acoustical friction pads between the steel base plate and the support. All mountings shall have leveling bolts that shall be rigidly bolted to the equipment. Springs shall have a minimum additional travel equal to 50 percent of the rated deflection. Vibration isolators shall be Mason Industries Type SLFH or equal.

2.1.3 Neoprene Mounting Type

2.1.3.1 Performances of neoprene mounting type vibration devices equipment shall be adequate for the associated rotating equipment. The following parameters shall be in accordance with the rotating equipment manufacturer's recommendations.

A. Load carrying capacity

B. Deflection

2.1.3.2 Neoprene type vibration isolators shall be double deflection type neoprene mounting of less than 55 durometer. All metal surfaces shall be neoprene covered to avoid corrosion. Cast-in steel base plate with mounting holes shall be provided to allow the isolators to be bolted to the support structure. Neoprene vibration isolators shall be Mason Industries Type ND or equal.

2.1.4 Isolation Efficiency

All vibration isolators shall have an isolation efficiency of not less than 90 percent. All parameters shall be in accordance with recommended methods specified in ASHRAE, Systems and Applications, Chapter 52, sections entitled "Vibration Isolator Selection Guide" and "Vibration Isolators - Materials, Types and Configurations."

2.2 **FABRICATION AND MANUFACTURE**

(Not Used)

2.3 **LABELING**

In addition to the manufacturer's identification nameplate, each vibration isolation device shall be supplied with a corrosion-resistant metal tag identification in accordance with Specification Section 15196, Paragraph 2.2.2.9.

2.4 **PACKAGING**

Preparation for shipment and packing shall conform to the manufacturer's standards and shall provide protection against corrosion and damage from normal handling. Preparation shall include the following:

2.4.1 Machined surfaces and threads shall be protected during shipment by application of grease or other suitable rust prohibiting compound.

2.4.2 Temporary bracing, supports, and rigging connections shall be provided as necessary to prevent damage during shipment, lifting, and unloading.

2.4.3 Separate or loose parts shall be completely boxed and attached to the main device and shipped as a unit. All shipping boxes shall be identified with the related equipment number(s) and description of the equipment, Seller's purchase order number, description of the vibration isolation device, manufacturer's name, Seller's name, project identification, and destination with ink, paint, or other indelible material. A copy of the packing list shall be securely affixed to the outside of each package or crate.

PART 3 EXECUTION

3.1 **PREPARATION**

Before installation, Seller shall review all pertinent documentation and verify the following:

3.1.1 All documentation (data and drawings) required by Paragraph 1.6 of this specification has been submitted to the Buyer.

3.1.2 The Seller has received from the Buyer approved specifications and Contract Drawings covering all equipment where the vibration isolation devices are to be installed.

3.1.3 Inspect each vibration isolation device to make sure that it is complete with all accessories.

3.1.4 Inspect the foundation, pad or structural steel member on which the vibration isolation device will be installed to make sure that anchor bolts (or bolt holes in case of a structural steel member) for the isolators are located to match the positions of the isolator base plate bolt holes.

3.2 **INSTALLATION, APPLICATION AND ERECTION**

Install each vibration isolation device in accordance with the manufacturer's instructions, specifications and Contract Drawings.

3.3 **FIELD QUALITY CONTROL**

3.3.1 Inspection and testing shall be performed as required by field inspection and checkout checklist (Attachment A).

3.4 **ADJUSTMENTS**

(Not Used)

3.5 **CLEANING**

(Not Used)

3.6 **PROTECTION**

(Not Used)

3.7 **DEMONSTRATION**

(Not Used)

3.8 **SCHEDULES**

(Not Used)

END OF SECTION

ATTACHMENT A
FIELD INSPECTION AND CHECKOUT CHECKLIST

VIBRATION ISOLATION DEVICES

Equipment Number _____ Purchase Order No. _____

Location _____

Installed By _____ Mfr. _____

Specification No. _____ Rev. _____ Dwg. No. _____ Rev. _____

NOTES: 1) This checklist covers the general requirements for the inspection and testing of equipment for start-up. It should be used in conjunction with the manufacturer's installation, testing and operating instructions.
2) All test equipment and instrumentation shall be properly calibrated per manufacturer's instructions. Items out of calibration or damaged shall not be used for testing.
3) Record all defects, missing parts, etc., and action taken to correct.

Items to Inspect/Check/Test	Installation Meets Requirements Signature	Recorded Data Remarks
(Inspection/check/test procedures to be detailed in this section. Items should be listed in the order to be accomplished.)		

PROCEDURE APPROVAL — SELLER REPRESENTATIVE _____ DATE _____

PROCEDURE APPROVAL — BUYER'S REPRESENTATIVE _____ DATE _____

TEST COMPLETION ACKNOWLEDGEMENT — SELLER REPRESENTATIVE _____ DATE _____

TEST COMPLETION ACKNOWLEDGEMENT — BUYER'S REPRESENTATIVE _____ DATE _____

U.S. DEPARTMENT OF ENERGY
Hanford Waste Vitrification Plant
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FLUOR DANIEL, INC.
Advanced Technology Division
Fluor Contract 8457

SECTION 15258
THERMAL INSULATION
FOR DUCTWORK AND PIPING
B-595-C-E350-15258

APPROVED FOR CONSTRUCTION

REVISION 1 PER CR-0859
ISSUE DATE 8/4/93

WAPA YES ___ NO X
QUALITY LEVEL I ___ II X
SAFETY CLASS 1__ 2__ 3 X 4__

ORIGINATOR:

Behzad Entezam 7,8,93
B. Entezam, HVAC Engineer Date

CHECKER:

R. E. Flye 7.8.93
R. E. Flye, HVAC Engineer Date

APPROVED BY:

Manuel G. Mercado 7/14/93
M. G. Mercado Lead Discipline Engineer Date

SECTION 15258
THERMAL INSULATION
FOR DUCTWORK AND PIPING
B-595-C-E350-15258

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SECTION 15258
THERMAL INSULATION
FOR DUCTWORK AND PIPING

PART 1 GENERAL

1.1 SUMMARY

This section defines the minimum technical requirements for furnishing, installing and checking out thermal insulations and vapor barriers for ductwork, refrigerant piping, and outdoor piping. Outdoor piping shall be insulated when designated as insulation code ET(W) on the Contract Drawings.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B209	1990 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C177	1985 Standard Test Method for Steady-State Heat Flux Measurement and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
ASTM C533	1989 Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation
ASTM C534	1988 Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
ASTM C1136	1990 Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation

THERMAL INSULATION MANUFACTURERS ASSOCIATION

TIMA	1988 Energy Saving Guide - Recommended Thickness for Pipe and Equipment Insulation

FEDERAL SPECIFICATIONS (FS)

FS-HH-I-558	1976 Insulation Blocks, Boards, Blankets, Felt, Sleeving (Pipe and Tube Covering) and Pipe Fitting Covering, Thermal (Mineral Fiber Industrial Type) [Rev. B, Amendment 3]

UNDERWRITERS LABORATORIES, INC. (UL)

UL 723	1983 (R 1987) Surface Burning Characteristic of Building Materials, Sixth Edition

1.3 **RELATED REQUIREMENTS**

(Not Used)

1.4 **DEFINITIONS**

(Not Used)

1.5 **SYSTEM DESCRIPTION**

(Not Used)

1.6 **SUBMITTALS**

Submit the following in accordance with the Vendor Drawing and Data Requirements section of the Order/Subcontract.

1.6.1 Product Literature - Descriptive literature, catalog sheets and performance data for each type of material with manufacturer's name, product name, location of use, and thermal conductivity "k" value per ASTM C177.

1.6.2 Samples - Provide samples of all insulation material and accessory materials to be used on this project. Each sample shall be labeled with manufacturer's name, product name, location of use, and thermal conductivity "k" value per ASTM C177.

1.6.3 Application and Installation Instructions - Detailed application and installation instructions shall be submitted to the Buyer. In addition, a copy of each shall be shipped with the material.

1.6.4 Inspection and Checkout List - The Seller shall prepare a checklist for the inspection and checkout of the thermal insulation using the format of Attachment A or other form that includes all the information requested in Attachment A. This checklist shall be submitted to the Buyer and shall include the following as a minimum:

A. Materials are installed in accordance with the manufacturer's recommendations, Contract Drawings, and this specification.

B. Finished installation is clean, undamaged, and free of foreign material.

C. Insulation is continuous on all surfaces which require insulation.

D. Insulation is continuous at supports.

E. Extent of insulation and thicknesses are in accordance with this specification, and Contract Drawings.

1.6.5 Construction Acceptance Test (CAT) - Inspection and Testing per Paragraph 3.3.1 of this specification.

1.7 **CLASSIFICATION OF SYSTEM AND COMPONENTS**

(Not Used)

1.8 **PROJECT OR SITE ENVIRONMENTAL CONDITIONS**

(Not Used)

PART 2 PRODUCTS

2.1 **MATERIALS AND EQUIPMENT**

2.1.1 General

Insulation materials shall have a flame spread rating not to exceed 25 and a maximum smoke development rating of 50 when tested in accordance with UL 723. This requirement applies to the insulating material and any vapor barriers, coverings or wrappings whether permanently attached or installed separately. All insulating material, including vapor barrier covering and protective jacketing that is applied with such adhesive or separately tested adhesive shall comply with the above requirements.

2.1.2 Insulation Materials

2.1.2.1 Ductwork Insulation

Where ductwork system insulation is called for on Contract Drawings, exterior surfaces of ductwork systems shall be insulated with rigid fiberglass board insulation nominal 6 pounds per cubic foot density with an integral vapor barrier facing consisting of an embossed laminate of Kraft paper, fiberglass yarn reinforcement

and 0.002" thick (min.) aluminum foil. Insulation materials shall conform to Federal Specification HH-I-558B and vapor barrier materials shall conform to ASTM C1136. The insulation board shall be Johns-Manville No. 817 "Spin-glas" or equal, and shall have a "k" factor of 0.25 maximum at 75°F mean temperature.

2.1.2.1.1 Accessory Materials for Ductwork Insulation

A. Mechanical fasteners shall be welded to metal duct surfaces using weld clips as manufactured by Duro Dyne Corporation, or equal. Weld clips shall be welded in accordance with manufacturer's recommendations. Apply zinc coating to all weld surfaces.

B. Adhesive shall be Benjamin-Foster No. 85-15 nonflammable adhesive, or equal.

C. Insulation corner angles shall be 20 gauge aluminum with 1-1/2 inch legs. Aluminum material conforming to ASTM B209.

D. Tape used to seal insulation shall be 3 inch wide vapor barrier tape with factory applied pressure sensitive adhesive compatible with the facing on the board insulation.

2.1.2.1.2 Thickness of Insulation

The thickness of ductwork insulation not including reinforcement or finish material shall be 1½" inch nominal thick in reference with TIMA energy saving guide.

2.1.2.1.3 Insulation Cover

Where shown or noted on the Contract Drawings, provide ductwork insulation with 24 gauge thick aluminum conforming to ASTM B209. Insulation covers shall be secured in-place with 3/4-inch wide (minimum) x 26 gauge thick aluminum or stainless steel bands.

2.1.2.2 Refrigerant Piping Insulation

2.1.2.2.1 Refrigerant piping insulation shall be cellular elastomer pipe thermal insulation, 2 pound density, 1½ inch thick and conforming to ASTM C534, with water vapor permeability not exceeding 0.30 perms. Sections and fittings shall be molded for tight fit to piping. Insulation adhesives shall be compatible with the insulation as recommended by the insulation manufacturer. Refrigerant piping insulation shall be Armstrong "AP Armaflex" or equal pipe insulation.

2.1.2.2.2 Refrigerant piping insulation shall be provided with weather protection finish, such as Armstrong "Armaflex-Finish" lacquer type coating or equal.

2.1.2.3 Outdoor Pipe Insulation

2.1.2.3.1 Outdoor pipe insulation shall be a calcium silicate pipe cover conforming to ASTM C533, Type I. The thickness of the insulation shall be 1 inch for lines up to 4" NPS and 1 1/2 inch for lines greater than 4" NPS. Manville "Thermo 12", Owens Corning "Kaylo", Pabco "Super Cal Temp" or equal.

2.1.2.3.2 Outdoor insulation for fittings shall be premolded, continuous or mitered, fitting covers manufactured from calcium silicate pipe covers as specified in Paragraph "B" above, or fibrous insulation conforming to FS-HH-I-558B Pabco, "Hamfab" or equal.

2.1.2.3.3 Removable covers for flanges and valves shall be per Attachment B.

2.1.2.4 Jacketing and Securement for Outdoor Piping Insulation

2.1.2.4.1 Jacketing shall be aluminum with factory applied polykraft moisture barrier, ASTM B209, Alloy 3003 H-14 or 5005 H-14. The aluminum jacketing shall be primed and finished with a light gray baked-on enamel coating. Childers Product or equal.

A. 0.016" thick x 3/16" corrugated for straight piping.

B. 0.010" thick flat prefabricated covers for fittings.

2.1.2.4.2 Securement

A. 16 gauge galvanized annealed iron wire for securing pipe insulation.

B. 1/2" wide x .015" thick, type 304 stainless steel bands for metal jacket.

C. Heavy duty type 304 stainless steel wing seals for piping.

D. #8 x 1/2" long, self tapping slotted pan head, type 302 or 304 stainless sheet metal screws with integral neoprene washer. Rockford "TEKS" or equal.

2.1.2.5 Flashing Compound

Flashing Compound shall be an asphalt sealant. Childres "CP-79 Stalastic" or equal.

2.2 **FABRICATION AND MANUFACTURE**

(Not Used)

2.3 **PACKAGING**

Preparation for shipment and packing shall conform to the manufacturer's standards and shall provide protection against deterioration and damage from normal handling. Preparation shall include the following:

2.3.1 Temporary bracing, supports, and rigging connections shall be provided as necessary to prevent damage during shipment, lifting, and unloading.

2.3.2 Separate or loose parts shall be completely boxed. All shipping boxes shall be identified with the Seller's purchase order number, description of the materials, manufacturer's name, Seller's name, project identification, and destination with ink, paint, or other indelible material. A copy of the packing list shall be securely affixed to the outside of each package or crate.

PART 3 EXECUTION

3.1 **PREPARATION**

3.1.1 Before installation, Seller shall review all pertinent documentation and verify the following:

3.1.1.1 All documentation (data and samples) required by Paragraph 1.6 of this specification has been submitted to the Buyer.

3.1.1.2 The Seller has received from the Buyer approved specification and Contract Drawings covering all equipment and piping to be installed.

3.1.1.3 Insulation materials must be kept dry and shall <u>not</u> be applied to wet surfaces. If insulating materials or surfaces become wet after application, they shall be allowed to dry or shall be replaced before proceeding with additional applications.

3.1.1.4 All ductwork and piping system pressure tests shall be completed before insulation is installed. If insulation is applied before testing, all welds, joints, threads, and bolted connections shall be left uninsulated and exposed until completion of testing.

3.2 INSTALLATION, APPLICATION AND ERECTION

3.2.1 Installation

3.2.1.1 General

Install insulations in accordance with the manufacturer's recommended procedures, the Contract Drawings, and as indicated in this specification.

3.2.1.2 Ductwork Insulation

3.2.1.2.1 Neatly cut and fit insulation to duct surfaces and around ductwork components such as dampers, coils, etc. with vapor barrier facing outward. Butt joint together and against standing seams. Secure insulation to sheet metal surface using mechanical fasteners spaced 18 inches on center line of bottom of duct.

3.2.1.2.2 Cover companion angles and reinforcements which project beyond insulation with half sections of preformed pipe insulation. Secure with bonding adhesive applied over 100 percent of area.

3.2.1.2.3 Secure corner angle to insulation at corners.

3.2.1.3 Refrigerant Piping Insulation

3.2.1.3.1 In exposed piping, locate insulation and cover seams in least visible locations.

3.2.1.3.2 Continue insulation with vapor barrier through penetrations.

3.2.1.3.3 Insulate fittings, joints, strainers and valves with insulation of like materials.

3.2.1.3.4 Apply protection finish coating in accordance with manufacturer's instructions.

3.2.1.4 Outdoor Piping Insulation

3.2.1.4.1 Flanges, valves, and indoor sections at traced lines up to but not including the heat trace power unit shall be insulated with removable covers per Attachment B.

3.2.1.4.2 Pipe insulation shall be stopped short of flanged connections a sufficient distance to permit removal of bolts without damage to the pipe insulation. On insulated flanges, the areas not covered by the pipe insulation shall be covered by the flange cover.

3.2.1.4.3 Horizontal piping without shoes shall have the insulation cut away on the bottom of the pipe for 5 to 6 inches on each side of the support, and the exposed surfaces of the insulation shall be sealed with flashing compound.

3.2.1.4.4 Fittings 2 inch NPS and smaller, shall be insulated with fabricated fibrous insulation covers to a thickness equal to insulation on adjacent piping.

3.2.1.4.5 Fittings shall be insulated with continuous or mitered prefabricated sections of pipe insulation,securely wired in place.

3.2.1.4.6 Pipe insulation shall be applied with longitudinal joints staggered and shall be secured with wire ties on 9 inch centers. The insulation shall be applied with all joints tight, broken or damaged sections shall not be used.

3.2.1.4.7 The Seller shall assure that rigid pipe covers fit snugly over the tracing. Measures such as using oversize or extended leg pipe cover, or grooving the inside of the pipe cover shall be employed if the diametrical tolerances of the pipe cover are not sufficient to ensure a snug fit.

3.2.1.5 Application of Outdoor Weatherproofing

3.2.1.5.1 A watertight metal flashing ring shall be installed at all insulation terminations.

3.2.1.5.2 Heavy fillets of flashing compound shall be applied at all penetrations through the insulation.

3.2.1.5.3 Below ground winterization protection insulation covering shall be suitably weatherproofed with wraps of heat-shrinkable tape and heat-shrinkable end caps.

3.2.1.5.4 Straight portions of insulated piping shall have the basic insulation covered with metal jacketing, with all joints lapped a minimum of 2 inches and arranged to shed water. The jacketing shall be secured with bands on 12 inches maximum centers, with a minimum of two bands per section of jacketing.

3.2.1.5.5 Fittings shall be weatherproofed with prefabricated metal fitting covers, banded or screwed in place.

3.3 FIELD QUALITY CONTROL

3.3.1 Inspection and testing shall be performed as required by field inspection and checkout checklist (Attachment A).

3.4 **ADJUSTMENTS**

(Not Used)

3.5 **CLEANING**

(Not Used)

3.6 **PROTECTION**

(Not Used)

3.7 **DEMONSTRATION**

(Not Used)

3.8 **SCHEDULES**

(Not Used)

END OF SECTION

ATTACHMENT A
FIELD INSPECTION AND CHECKOUT CHECKLIST

THERMAL INSULATION FOR DUCTWORK AND PIPING

Equipment Number _____ Purchase Order No. _____

Location _____

Installed By _____ Mfr. _____

Specification No. _____ Rev. _____ Dwg. No. _____ Rev. _____

NOTES: 1) This checklist covers the general requirements for the inspection and testing of equipment for start-up. It should be used in conjunction with the manufacturer's installation, testing and operating instructions.
2) All test equipment and instrumentation shall be properly calibrated per manufacturer's instructions. Items out of calibration or damaged shall not be used for testing.
3) Record all defects, missing parts, etc., and action taken to correct.

Items to Inspect/Check/Test	Installation Meets Requirements Signature	Recorded Data Remarks
(Inspection/check/test procedures to be detailed in this section. Items should be listed in the order to be accomplished.)		

PROCEDURE APPROVAL SELLER REPRESENTATIVE _____ DATE _____

PROCEDURE APPROVAL BUYER'S REPRESENTATIVE _____ DATE _____

TEST COMPLETION ACKNOWLEDGEMENT SELLER REPRESENTATIVE _____ DATE _____

TEST COMPLETION ACKNOWLEDGEMENT BUYER'S REPRESENTATIVE _____ DATE _____

ATTACHMENT B
REMOVABLE COVERS

1.0 Removable covers shall be laminate layers consisting of the following:

1.1 Inner layer - Knitted stainless steel mesh located against the hot surface.

1.2 Intermediate layer - Aluminum or stainless steel foil shall encapsulate the non-resinous fiberglass insulation blanket.

1.3 Insulation - Non-resinous glass or needled ceramic fiber sandwiched between outer jacketing and liners.

1.4 Weatherproofing - Silicone coated heavy duty fiberglass cloth applied on surface exposed to the atmosphere. It should not come in contact with surfaces over 500°F. The inner liner should come up and around to protect the edges on hot surfaces.

2.0 Materials for removable covers shall conform to the following:

2.1 Insulation shall be a mineral fiber conforming to ASTM C553, Type II. Pittsburgh Corning "Temp-Mat" or equal.

2.2 Intermediate liner shall be a fiberglass cloth suitable for temperatures up to 1000°F. Alpha Associates "1925/9383" or equal.

2.3 Quilting fasteners with self locking washers shall be stainless steel and of sufficient length for the insulation thickness, Alpha associates "AMQ-1202-SS" or equal.

2.4 Lacing hooks with self locking washers shall be stainless steel and of sufficient length for the insulation thickness,Alpha Associates "AMQ-1201-SS" or equal.

2.5 Thread shall be Teflon coated fiberglass for service to 300°F suitable for machine sewing, Alpha Associates "D-24" or equal.

2.6 Lacing wire shall be 16 gauge type 304 soft annealed stainless steel.

2.7 "Hog rings" shall be 18 gauge type 304 stainless steel, Alpha Associates or equal.

2.8 Foil shall be 0.002" (+0.0001" - 0.000") thick, aluminum.

2.9 Rivets shall be Olympic Fastening System "Olympic Bulb Tite, Type RV-6604-6 or -8 (x-length) W" or equal.

3.0 The covers shall be constructed such that at the edges of each section of the insulation cover, the liner shall be sewn or secured with "Hog rings" to the outer cover in a manner that totally encapsulates the insulation. Stainless steel "Hog rings" shall be used for services above 350°F.

4.0 Quilting fasteners shall be used to hold the laminar layers of insulation covers together. Lacing hooks shall be used to secure insulation cover sections together.

U.S. DEPARTMENT OF ENERGY
Hanford Waste Vitrification Plant
Richland, Washington
DOE Contract DE-AC06-86RL10838

FLUOR DANIEL, INC.
Advanced Technology Division
Fluor Contract 8457

SECTION 15400
PLUMBING
B-595-C-E350-15400

APPROVED FOR CONSTRUCTION

REVISION 1 PER CR-0859
ISSUE DATE 8/4/93

WAPA YES ___ NO X
QUALITY LEVEL I ___ II X
SAFETY CLASS 1__ 2__ 3X 4__

ORIGINATOR:

Ward Cumbie 20JUL93
W. Cumbie, Plumbing Engineer Date

CHECKER:

J L Datte 7-20-93
J. L. Datte, Architectural Lead Date

APPROVED BY:

J L Datte
J. L. Datte Architectural Lead

7-20-93
Date

SECTION 15400
PLUMBING
B-595-C-E350-15400

TABLE OF CONTENTS

SECTION 15400
PLUMBING

PART 1 GENERAL

1.1 SUMMARY

This section covers the technical requirements for furnishing and installing plumbing systems.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A112.19.5	1979 Trim for Water-Closet Bowls, Tanks, and Urinals
ANSI A112.21.1M	1980 Floor Drains
ANSI A112.21.2M	1983 Roof Drains
ANSI A112.36.2M	1983 (Errata 1984) Cleanouts
ANSI B16.18	1984 Cast Copper Alloy Solder Joint Pressure Fittings
ANSI B16.22	1989 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings (ANSI/ASME B16.22)
ANSI B16.23	1984 Cast Copper Alloy Solder Joint Drainage Fittings - DWV
ANSI B16.29	1986 Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV (ANSI/ASME B16.29)
ANSI B16.32	1984 Cast Copper Alloy Solder Joint Fittings for Solvent Drainage System (ANSI/ASME B16.32)

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A112.6.1M	1979 Supports for the Off-the-Floor Plumbing Fixtures for Public Use

ASME A112.18.1M	1989 Plumbing Fixture Fittings
ASME A112.19.1M	1987 Enameled Cast Iron Plumbing Fixtures
ASME A112.19.2M	1990 Vitreous China Plumbing Fixtures
ASME B16.26	1988 Cast Copper Alloy Fittings for Flared Copper Tubes (ASME/ANSI B16.26)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 47	1990 Ferritic Malleable Iron Castings
ASTM A 53	1990 (Rev. B) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 74	1987 Cast Iron Soil Pipe and Fittings
ASTM A 183	1983 (R 1990) Carbon Steel Track Bolts and Nuts
ASTM A 536	1984 Ductile Iron Castings
ASTM B 32	1989 Solder Metal
ASTM B 42	1989 Seamless Copper Pipe, Standard Sizes
ASTM B 88	1989 Seamless Copper Water Tube
ASTM B 306	1988 Copper Drainage Tube (DWV)
ASTM C 547	1977 Mineral Fiber Preformed Pipe Insulation
ASTM C 564	1988 Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM D 2000	1990 Rubber Products in Automotive Applications
ASTM F 441	1989 Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C105/A21.5	1988 Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids

AWWA C209	1990 Cold Applied Tape Coatings for the Exterior of Special Sections, Connections and Fittings for Steel Water Pipelines
AWWA C651	1986 (Addendum 1990) Disinfecting Water Mains

CAST IRON SOIL PIPE INSTITUTE (CISPI)

CISPI HSN	1985 Neoprene Rubber Gaskets for Hub and Spigot Cast Iron Soil Pipe and Fittings
CISPI 301	1990 Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
CISPI 310	1990 Couplings Joint for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings

INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS (IAPMO)

IAPMO UPC	1991 Uniform Plumbing Code (UPC)

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY, INC. (MSS)

MSS SP-58	1988 Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	1983 Pipe Hangers and Supports - Selection and Application
MSS SP-80	1987 Bronze Gate, Globe, Angle and Check Valves

UNDERWRITERS LABORATORIES INC. (UL)

UL 499	1991 Electric Heating Appliances

1.3 **RELATED REQUIREMENTS**

Specification Section 01730	Operation and Maintenance Data
Specification Section 02224	Excavating, Trenching and Backfill for Utilities
Specification Section 02720	Storm Drainage System
Specification Section 02730	Exterior Sanitary Sewer System
Specification Section 08305	Access Doors

1.4 **DEFINITIONS**

In the Plumbing Code referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for the word "should" wherever it appears; reference to the "authority having jurisdiction," the Administrative Authority, the Plumbing Official, and the Design Engineer shall be interpreted to mean the Buyer. Capacity of equipment shall be not less than that indicated.

1.5 **SYSTEM DESCRIPTION**

Provide plumbing systems, complete and ready for operation. Plumbing systems including manufacturer's products shall be in accordance with the required and advisory provisions of IAPMO UPC. Plumbing systems include piping less than 5 feet outside of building walls.

1.6 **SUBMITTALS**

Submit the following in accordance with the Vendor Drawing and Data Requirements section of the order/subcontract:

1.6.1 Manufacturer's Catalog Data:

A. Pipe and Fittings
B. Valves
C. Plumbing Fixtures
D. Water Heaters
E. Pipe Hangers and Supports
F. Drains
G. Pipe Insulation

1.6.2 Operation and Maintenance Manuals

Submit in accordance with Specification Section 01730, "Operation and Maintenance Data".

A. Water heaters

1.6.3 Test Reports

Test reports shall be submitted for hydrostatic pressure test of Domestic Water piping in accordance with paragraph 3.3.2.1 and water, air pressure and smoke or peppermint test of DWV Piping System in accordance with paragraph 3.3.2.2.

1.6.4 Sterilization Certificate

Disinfection Certificate shall be submitted for disinfection of water piping in accordance with paragraph 3.3.3.

1.7 CLASSIFICATION OF SYSTEM AND COMPONENTS

(Not Used)

1.8 PROJECT OR SITE ENVIRONMENTAL CONDITIONS

1.8.1 Climatic and Geographic Site Conditions

A.	Site Elevation	714 feet above sea level
B.	Barometric Pressure	14.3 psia
C.	Outside Design Temperature	
1)	Maximum Design Temperature	110°F
2)	Minimum Design Temperature	-20°F
D.	Minimum Snow Load	20 psf
E.	Rainfall Intensity	Maximum of 1 inch in 24 hour period

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Drain, Waste, and Vent (DWV) Piping

Fittings shall be long radius fittings, except fittings in vent piping may be short radius fittings. Minimum size piping shall be 2 inches for buried piping and 1.5 inches for aboveground piping.

2.1.2 Buried Piping

Provide piping up to but not more than 6 inches aboveground or floor slab on grade.

2.1.2.1 Cast-Iron Hub and Spigot Pipe and Fittings

ASTM A 74 with ASTM C 564 or CISPI HSN rubber compression gasket joints.

2.1.3 Aboveground Piping

2.1.3.1 Cast-Iron Hubless Pipe and Fittings

CISPI 301 with CISPI 310 couplings.

2.1.3.2 Copper Tubing

ASTM B 306, with ANSI B16.23, ANSI/ASME B16.29, or ANSI/ASME B16.32 solder joint fittings using ASTM B 32, 95-5 tin-antimony or Grade Sn96 tin-silver solder, and flux containing not more than 0.2 percent lead.

2.1.3.3 Grooved-End Steel Piping for Roof Drainage Only

ASTM A 53, Schedule 40, hot-dip galvanized, cut grooved-end steel pipe; ASTM A 47 or ASTM A 536, hot-dip galvanized, grooved-end fittings, and flexible mechanical couplings; ASTM A 183 coupling nuts and bolts; ASTM D 2000 rubber gaskets for water service. Fittings, flexible mechanical couplings, and rubber gaskets shall be supplied by the same manufacturer.

2.1.4 Cleanouts

ANSI A112.36.2M; provide threaded bronze cleanout plugs.

2.1.4.1 Wall Cleanouts

Provide polished stainless steel or chromium-plated copper alloy cover plate and secure to cleanout plug with countersunk stainless steel screw.

2.1.5 Drains

2.1.5.1 Floor Drains

ANSI A112.21.1M; provide cast iron or ductile iron body with clamping ring, double drainage flange, adjustable top, slotted tractor grate allowing 150 gallons per minute flow rate, inside caulk outlet and cast iron P-trap.

2.1.5.2 Roof Drains

ANSI A112.21.2M; provide hot-dip galvanized cast-iron or ductile-iron drains, with minimum of 10-inch diameter body, nonpuncturing flashing clamp device with integral gravel stop and deck clamp, and removable cast-iron or ductile-iron or polypropylene locking dome. Free area of dome shall be not less than two times the free area of drain outlet. Provide drain flashing ring seat flush with adjacent roof deck, and secure rigidly in place with deck clamp. Provide expansion joint with

cast iron body, adjustable bronze expansion sleeve and bronze bolts and wing nuts.

2.1.5.3 Overflow Roof Drains

Same as 2.1.5.2 except with 2-1/2 inch high by 4 inch diameter internal standpipe.

2.1.6 Domestic Water Piping

2.1.6.1 Buried Piping and Aboveground Piping

2.1.6.2 Copper Tubing

ASTM B 88, Type L or M for aboveground piping, Type K for buried piping, with ANSI B16.18 or ASME/ANSI B16.22 solder joint fittings; or with ASME/ANSI B16.26 flared joint fittings. Provide ASTM B 42 copper pipe nipples with threaded end connections. Provide ASTM B 32, 95-5 tin-antimony solder, or provide Plumbing Code approved lead-free solder. Provide copper tubing for pipe sizes 4 inches or smaller.

2.1.7 Water Valves

Provide valves suitable for minimum of 125 psig and minimum of 180 degrees F hot water. Valves shall have threaded end connections with a union on all but one side of the valve, or solder end connections for connections between bronze valves and copper tubing. Ball valves may be provided in lieu of gate valves.

2.1.7.1 Gate Valves

MSS SP-80, Class 125.

2.1.7.2 Ball Valves

Full port design, copper alloy. Valves shall have two-position lever handles.

2.1.7.3 Hose Bibbs

Provide angle type copper alloy hose bibb with lockshield and removable handwheel or tee-handle. Inlet shall have internal threads. Outlet shall have vacuum breaker with 0.75-inch external hose threads.

2.1.8 Dielectric Connections

Provide at connections between copper and ferrous metal piping materials. ASTM F 441, Schedule 80, CPVC threaded pipe nipples, 4-inch minimum length, may be provided for dielectric connections in pipe sizes 2 inches and smaller.

2.1.9 Miscellaneous Piping Materials

2.1.9.1 Escutcheon Plates

One piece or split hinge type metal plates for piping passing through floors, walls, and ceilings in exposed spaces, chromium-plated or polished stainless steel finish on copper alloy plates in finished spaces, paint finish on plates in unfinished spaces, and with set screws or other approved positive means to anchor plates in place securely.

2.1.10 Pipe Sleeves

2.1.10.1 Sleeves in Concrete Walls, Floors

ASTM A 53, Schedule 40 or Standard Weight, hot-dip galvanized steel pipe sleeves.

2.1.10.2 Sleeves in Non-Masonry or Non-Concrete Walls, Floors, and Roofs

Hot-dip galvanized steel sheet having a nominal weight of not less than 0.90 pound per square foot.

2.1.11 Pipe Hangers and Supports

Provide MSS SP-58 and MSS SP-69, Type 1 with adjustable type steel support rods, except as specified or indicated otherwise. Attach to steel joints with Type 19 or 23 clamps and retaining straps. Attach to Steel W or S beams with Type 21, 28, 29, or 30 clamps. Attach to steel angles and vertical web steel channels with Type 20 clamp with beam clamp channel adapter. Attach to horizontal web steel channel with drilled hole on centerline and double nut and washer. Attach to concrete with Type 18 insert or drilled expansion anchor. Provide Type 40 insulation protection shield for insulated piping.

2.1.12 Access Doors

Provide 12- by 12-inch factory prefabricated steel access doors including steel door frame in accordance with Specification Section 08305, "Access Doors".

2.1.13 Fixtures, Fittings, Accessories, and Supplies

Provide control-stop valves in each supply to each fixture. The finish of fittings, accessories, and supplies exposed to view shall be chromium-plated per ASME A112.18.1M. Centerset faucets shall be top-mounted with inlets on not greater than 4-inch centers.

2.1.13.1 Flush Valve Type Water Closets P-1

ASME A112.19.2M, white vitreous china, wall-mounted, wall outlet, siphon jet, elongated bowl, black solid plastic elongated open-front seat, and ANSI A112.19.5 trim. Provide large diaphragm (not less than 2.625 inches upper chamber inside diameter at the point where the diaphragm is sealed between the upper and lower chambers) nonhold-open flush valve of chrome plated cast brass, including vacuum breaker and angle (control-stop) valve with back check, mounted approximately 39 to 44 inches above floor. The water flushing volume of the flush valve and water closet combination shall not exceed 3.5 gallons per flush from 15 to 90 psi. Provide ASME A112.6.1M carrier with feet.

2.1.13.2 Lavatories P-2

ASME/ANSI A112.19.1M, white enameled cast-iron, or ASME A112.19.2M white vitreous china with ASME A112.6.1M concealed arm carrier support, shelf back type, minimum dimensions of 20 inches wide by 18 inches front to rear. Provide ASME A112.18.1M copper alloy centerset faucets with aerator, perforated grid strainers, and 1.25-inch adjustable P-traps. Provide ASME A112.6.1M concealed chair carriers.

2.1.14 Plumbing Fixture Faucets, Trim, and Fittings

ASME A112.18.1M for plumbing fixture faucets. The finish of plumbing fixture faucets, trim, valves, and fittings exposed to view shall be chromium-plated or polished stainless steel except as modified herein. Handles may be clear plastic. Bolts, nuts, and screws shall be copper alloy or stainless steel. Provide globe valves or angle valves, and union connections in each supply to each faucet; chromium-plated finish is not required. Faucets shall be washerless type and shall have threaded type end connections, coupling nuts, or union connections. Faucets may be of the single control type. Provide washers and locknuts to secure faucets to lavatories.

A. Traps

Provide P-traps for each plumbing fixture which does not have integral traps. Provide 1.5 inch white PVC adjustable P-traps and tubing with slip nuts and gaskets; chromium-plated finish is not required.

B. Lavatory Faucets

Provide washerless faucets including aerators, drain outlets, and drain tail pieces for each lavatory. Provide perforated grid strainers for each lavatory. Faucet handles shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist; maximum force required to operate faucet handles shall be 5 pounds of force.

2.1.15 Domestic Water Heaters (Electric)

UL 499 instantaneous electric water heaters with single heating element, to provide 41 degrees F temperature rise at 1.0 gpm flow rate. Provide posted operating instructions for water heaters.

2.1.16 Nameplates

Provide laminated plastic nameplates for equipment and valves; stop valves in supplies to fixtures will not require nameplates. Laminated plastic shall be 0.125-inch thick melamine plastic, black with white center core. Surface shall be a matte finish. Corners shall be square. Accurately align lettering and engrave into the white core. Minimum size of nameplates shall be 1.0 inch by 2.5 inches. Lettering shall be minimum of 0.25-inch high normal block lettering. Key nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed near each system. Furnish two copies of each chart and schedule. Each inscription shall identify its function. Equipment nameplates shall show the following information:

A. Manufacturer, type, and model number

B. Contract number and accepted date

C. Capacity or size

D. System in which installed

E. System which it controls

2.1.17 Insulation

Provide 1.0 inch thick fiberglass insulation with factory applied jacket conforming to ASTM C 547 on domestic hot and cold water piping, roof drain and over-flow roof drain bodies and all horizontal roof drain and overflow roof drain piping.

2.2 **FABRICATION AND MANUFACTURE**

(Not Used)

PART 3 EXECUTION

3.1 **PREPARATION**

(Not Used)

3.2 **INSTALLATION, APPLICATION AND ERECTION**

Installation of plumbing systems including fixtures, equipment, materials, and workmanship shall be in accordance with the Plumbing Code, except as modified herein. When fixtures require both hot water and cold water supplies, provide the hot water supply to the left of the cold water supply.

3.2.1 Threaded Connections

Jointing compound for pipe threads shall be polytetrafluoroethylene (PTFE) pipe thread paste, pipe cement and oil, or PTFE powder and oil; apply only on male threads. Provide exposed ferrous pipe threads with one coat of primer applied to a minimum dry film thickness of 1.0 mil.

3.2.2 Solder End Valves

Remove stems and washers and other item subject to damage by heat during installation. Reassemble valve after soldering is completed. Valves without heat sensitive parts do not require disassembly but shall be opened at least two turns during soldering.

3.2.3 Pipe Supports (Hangers)

Provide additional supports at the concentrated loads in piping between supports, such as for flanged valves.

3.2.3.1 Piping to Receive Insulation

Provide temporary wood spacers between the insulation protection shield and the pipe in order to properly slope the piping and to establish final elevations. Temporary wood spacers shall be of the same thickness as the insulation.

3.2.3.2 Maximum Spacing Between Supports

A. Vertical Piping

Support metal piping at each floor, but at not more than 10-foot intervals, with pipe riser clamps or offset pipe clamps.

B. Horizontal Piping

Support cast-iron piping at 5-foot intervals, except for pipe exceeding 5-foot length, provide supports at intervals equal to the pipe length but not exceeding 10 feet. Support steel piping and copper tubing as follows:

Nominal Pipe Size (Inches)	One and Under	1.25	1.5	2	2.5	3	3.5	4	5	6
Steel Pipe	7	8	9	10	11	12	13	14	16	17
Copper Tube	6	7	8	8	9	10	11	12	13	14

3.2.4 Buried Piping

A. Completely encase buried copper water piping and cast iron DWV piping with polyethylene tube or sheet in accordance with AWWA C105/A21.5.

B. Plumbing takeoff from point of connection shall be tape wrapped per AWWA C209.

C. All copper potable water piping shall be isolated from metal to metal contact with reinforcing steel in concrete floor slabs and footings with plastic sleeves. Potable water lines entering the building through floor shall have a dielectric coupling installed above the floor slab upstream of the main shutoff valve.

3.2.5 Installation of Pipe Sleeves

Provide pipe sleeves where piping passes through walls, floors, roofs, and partitions. Secure sleeves in proper position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, floors, roofs,

and partitions. Provide not less than one inch space between exterior of piping or pipe insulation and interior of sleeve or core-drilled hole. Firmly pack space with mineral wool insulation. Seal at both ends of the sleeve or core-drilled hole with plastic waterproof cement which will dry to a firm but pliable mass, or provide a mechanically adjustable segmented elastomeric seal. Seal both ends of penetrations through fire walls and fire floors to maintain fire resistive integrity with UL listed fill, void, or cavity material. Extend sleeves in floor slabs 3 inches above the finished floor, except sleeves are not required where DWV piping passes through concrete floor slabs located on grade.

3.2.6 Copper Tube Extracted Joint

An extracted mechanical tee joint may be made in copper tube. Make joint with an appropriate tool by drilling a pilot hole and drawing out the tube surface to form a collar having a minimum height of three times the thickness of the tube wall. To prevent the branch tube from being inserted beyond the depth of the extracted joint, provide dimpled depth stops. Notch the branch tube for proper penetration into fitting to ensure a free flow joint. Braze extracted joints using a copper phosphorus classification brazing filler metal. Soldered joints shall not be permitted.

3.3 FIELD QUALITY CONTROL

3.3.1 Inspections

Prior to initial operation, inspect piping system for compliance with drawings, specifications, and manufacturer's submittals.

3.3.2 Field Testing

Before final acceptance of the work, test each system as in service to demonstrate compliance with the contract requirements. Perform the following tests in addition to the tests specified in the Plumbing Code, except as modified herein. Correct defects in the work provided by the Contractor, and repeat tests until work is in compliance with contract requirements. Furnish water, electricity, instruments, connecting devices, and personnel for performing tests.

3.3.2.1 Domestic Water Piping

Before applying insulation, hydrostatically test each piping system at not less than 100 psig with no leakage or reduction in gage pressure for 2 hours.

3.3.2.2 DWV Piping

Before the installation of fixtures, cap ends of each system, fill piping with water to the roof, and allow to stand until a thorough inspection has been made. If the system is tested in sections, each opening shall be plugged and each section tested with not less than a 10-foot head of water. After plumbing fixtures have been set and their traps filled with water, subject the entire sanitary system to a final air pressure test of not more than 1.0 inch of water column and a smoke or peppermint test. Perform the air and smoke test with an approved smoke testing machine which shall show a clear passage of smoke and air throughout the entire system. The entire system shall be proven absolutely tight under such test.

3.3.3 Disinfection

Disinfect new water piping in accordance with AWWA C651. Fill piping systems with solution containing minimum of 50 parts per million of available chlorine and allow solution to stand for minimum of 24 hours. Flush solution from the systems with clean water until maximum residual chlorine content is not greater than 0.2 parts per million or residual chlorine content of domestic water supply. Obtain at least two consecutive satisfactory bacteriological samples from new water piping, analyze by a certified laboratory, and submit the results prior to the new water piping being placed into service.

3.4 **ADJUSTMENTS**

(Not Used)

3.5 **CLEANING**

On completion, remove all excess material and debris from the project site.

3.6 **PROTECTION**

(Not Used)

3.7 **DEMONSTRATION**

(Not Used)

3.8 **SCHEDULES**

(Not Used)

END OF SECTION

U.S. DEPARTMENT OF ENERGY
Hanford Waste Vitrification Plant
Richland, Washington
DOE Contract DE-AC06-86RL10838

FLUOR DANIEL, INC.
Advanced Technology Division
Fluor Contract 8457

SECTION 15501
AUTOMATIC WET PIPE SPRINKLER SYSTEM
B-595-C-E350-15501

APPROVED FOR CONSTRUCTION

REVISION 1
ISSUE DATE 8/4/93

WAPA YES ___ NO X
QUALITY LEVEL I ___ II X
SAFETY CLASS 1__ 2__ 3 X 4__

ORIGINATOR:

N. M. Ruonavaara 08-02-93
N. M. Ruonavaara, Fire Prot. Eng. Date

CHECKER:

August 2, 1993
J. L. Kubicek, Fire Protection Eng. Date
FOR JL KUBICEK

APPROVED BY:

N. M. Ruonavaara
N. M. Ruonavaara Lead Discipline Engineer

08-02-93
Date

SECTION 15501
AUTOMATIC WET PIPE SPRINKLER SYSTEM
B-595-C-E350-15501

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SECTION 15501
AUTOMATIC WET PIPE SPRINKLER SYSTEM

PART 1 GENERAL

1.1 SUMMARY

This specification section, when accompanied by the related requirements, Contract Drawings and specifications, covers the requirements for the design, materials, fabrication, installation, application of coating materials, inspection and testing of the automatic sprinkler and fire alarm systems for the Canister Storage Building. The Hanford Waste Vitrification Plant is located in an area subject to earthquakes. Connections to the system supply shall be per Contract Drawings referenced in Paragraph 1.3 of this specification section.

The Seller shall be licensed in the State of Washington and fully qualified for the design, analysis, fabrication, and installation of automatic sprinkler and fire alarm systems.

1.2 REFERENCES

The publications listed below form a part of this specification section.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B1.20.1	1983 Pipe, Threads, General Purpose (Inch)

FACTORY MUTUAL (FM)

FM P7825	1990 Approval Guide
FM DATA SHEET 2-8	Sprinkler Systems

INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS

1991	Uniform Building Code (UBC)
1991	Uniform Building Code Standards (UBC 38-1)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	1985 Enclosures for Electrical Equipment (1000 Volts Maximum), Revisions 2, 1988

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 13	1991 Installation of Sprinkler Systems
NFPA 70	1990 National Electrical Code
NFPA 72	1990 Standard for the Installation, Maintenance and Use of Protective Signalling Systems
NFPA 1963	1985 Standard for Screw Threads and Gaskets for Fire Hose Connections

UNDERWRITERS LABORATORIES INC. (UL)

1990	Fire Protection Equipment Directory

1.3 **RELATED REQUIREMENTS**

Drawing H-2-122747	Electrical Canister Storage Building Communications and Fire Alarm System Riser Diagram
Drawing H-2-122748	Electrical Canister Storage Building Communications and Fire Alarm System Plan
Drawing H-2-122746	Electrical Canister Storage Building Instrument Sections and Details
Specification Section 07900	Sealants
Specification Section 09900	Painting
Specification Section 16100	Electrical Installation
Specification Section 16110	Electrical Materials and Devices
Specification Section 17697	Smoke Detectors

1.4 **DEFINITIONS**

(Not Used)

1.5 **SYSTEM DESCRIPTION**

The design, materials, fabrication, installation, and testing of the automatic sprinkler and fire alarm systems shall comply with the requirements listed in Section 1.2. All devices shall be listed in UL Product Directory and/or the FM Approval Guide for use in fire protection systems.

Automatic wet pipe sprinkler systems shall be provided in the entire Canister Storage Building first floor in accordance this specification and the Contract Drawings. The air intake structures and below grade vault areas are not sprinklered. Sprinkler systems shall be designed for a minimum of 0.20 gpm per square foot over the remote 2000 square foot area. Hose stream requirements shall be a minimum of 500 gpm. The determination of the adequacy of the water supply shall be made based on actual flow tests gathered using methods in NFPA 13, Appendix B. The flow test shall be in accordance with the Buyer's specified location and time. All material shall be supplied by the Seller.

1.6 **SUBMITTALS**

Submit the following in accordance with the Vendor Drawing and Data Requirements section of the Order/Subcontract.

1.6.1 Seller shall supply shop drawings with schematics to facilitate Buyer evaluation of each system's coverage.

1.6.2 Drawings and data submittal shall include information and calculations as required by NFPA 13, Section 5-2 and Chapter 6 and 7.

1.6.3 Catalog information including overall dimensions, model number, material and connection sizes for all furnished equipment. (i.e., valves, gauges, panels, switches, etc.)

1.6.4 Installation details.

1.6.5 Structural supports.

1.6.6 Complete data sheets for each type of material, equipment, procedure, and calculation.

1.6.7 Installation, operating, and maintenance manuals.

1.6.8 Component drawings.

1.6.9 Testing procedures and list of testing equipment.

1.6.10 Recommended spare parts list, including enough information to permit procurement from the original manufacturer of subsupplier.

1.6.11 Washington State license.

1.6.12 Hydraulic design calculations in accordance with Sections 1.2 and 1.5.

1.6.13 As-built drawings and hydraulic calculations in accordance with Sections 1.2 and 1.5.

1.6.14 Cleaning and painting procedures.

1.6.15 Construction inspection test package in accordance with Paragraph 2.6.1.

1.6.16 Inspection test report in accordance with Paragraph 2.6.2.

1.7 **CLASSIFICATION OF SYSTEMS AND COMPONENTS**

(Not Used)

1.8 **PROJECT OR SITE ENVIRONMENTAL CONDITIONS**

1.8.1 Climatic and Geographic Site Conditions

A. Site Elevation 714 feet above sea level

B. Barometric Pressure 14.3 psia

C. Outside Design Temperature

1) Maximum Design Temperature 110°F

2) Minimum Design Temperature -20°F

3) Wet Bulb Design Temperature 68°F

1.8.2 Operating Environment

A. Operating Temperature 60° - 104°F

B. Relative Humidity Not controlled

PART 2 PRODUCTS

2.1 **MATERIALS AND EQUIPMENT**

2.1.1 Piping and Fittings

All pipe and fittings shall be supplied in accordance with the requirements of NFPA 13.

2.1.2 Fire Department Connections

2.1.2.1 Fire department connection hose threads shall be American National fire hose connection and in accordance with NFPA 1963. Hose valve outlet pipe threads must be approved by the Buyer before installations. The unit shall be polished cast brass, with two straight 2-1/2 inch fire department inlets, brass double clapper

valves, brass rocker lug caps and chains, and cast-in function identifying lettering conforming to the requirements of NFPA 13.

2.1.2.2 Automatic ball drip valves shall be cast brass with 1/2 inch ANSI B1.20.1 threads with rough brass finish.

2.1.3 Sprinkler Riser Alarm Equipment

2.1.3.1 The alarm check valves and trim materials shall be standard swing check type with elastomer seat and shall be provided with standard accessories and standard and special trim necessary to give an alarm, including retard chamber, 10 inch electric bells with weatherproof enclosure, pressure gauges, testing and drain provisions and all necessary intercomponent piping, fittings and valves. A trim pressure relief valve shall be installed to prevent excess pressure in the sprinkler piping.

2.1.4 Sprinkler Head Types

2.1.4.1 Sprinkler heads shall be upright type fusible link natural brass with a temperature rating in accordance with NFPA 13. The sprinkler heads shall be provided with guards where mechanical damage is likely to occur. Pendant type chrome sprinklers and escutcheon plates shall be provided in office areas with finished ceilings.

2.1.5 Supervisory Switches

2.1.5.1 Supervisory switches shall be installed where required by Section 1.2 and be provided with normally open contacts. Switches shall be mounted so as not to interfere with the normal operation of the valve and shall be adjusted to operate within two revolutions of the valve control or when the stem has turned no more than 1/5 of the distance from its normal position. The mechanism shall be contained in a weatherproof housing, which shall be provided with 3/4 inch threaded conduit entrance and incorporate the necessary facilities for attachment to the valve. Switch housings shall be painted red. The switch mechanism shall have a rating of 5 amps at 125 Vac -0.25 amp at 125 Vdc. The entire installed assembly shall be arranged to cause a switch operation if the unit is removed from its mounting. Tag No. ZSL-FWX-313.

2.1.6 Wafer Check Valves

2.1.6.1 The fire department wafer check valves shall be cast iron with red paint finish, steel clapper, and with an elastomer seat.

2.1.7 Pressure Switches

2.1.7.1 Pressure switches shall be two single pole, double throw (SPDT), Snap Action, United Electric 115-Series or equal. Tag No. PSH-FWX-315.

2.1.7.2 Switch housings shall be designed for NEMA 4 in accordance with NEMA 250.

2.1.7.3 Process connection shall be 1/2 female national pipe thread (FNPT) and electrical conduit connection shall be 3/4 inch FNPT hub.

2.1.7.4 Setpoint shall be adjustable by means of an internal screw.

2.1.7.5 All switches shall be set to the actuation point prior to installation.

2.1.7.6 Switch setpoints shall be adjustable over the full input range.

2.1.7.7 Switch shall be snap acting type rated 5 amperes minimum at 120 Vac, noninductive.

2.1.7.8 Setpoint repeatability shall be within ±1 percent of full scale throughout entire setpoint range.

2.1.7.9 Setpoint differential (dead band) shall be fixed and shall not be more than 3 percent of the switch setting.

2.1.7.10 Proof pressure shall be at least 150 percent of the switch range.

2.1.7.11 Threaded connections shall be in accordance with ANSI B1.20.1.

2.1.8 Flow Orifice

2.1.8.1 The inspector's test connections shall include a smooth bore corrosion resistant orifice giving a flow equivalent of one sprinkler simulating the least flow from an individual sprinkler in the system.

2.1.9 Pressure Gauges

2.1.9.1 Pressure gauges shall be 4-1/2 inch diameter, Ashcroft Model No. 13795 or equal. Tag Numbers PI-FWX-314-1 (inlet) and PI-FWX-314-2 (outlet).

2.1.9.2 Connection shall be 1/2 inch male national pipe thread (MNPT) for local mounting.

2.1.9.3 Pressure elements shall be 316 stainless steel.

2.1.9.4 Pressure gauge movements shall be hardened stainless steel. Bronze or stainless steel may be used with bronze tubes.

2.1.9.5 Overpressure protection shall be 1 and 1/3 times the maximum tube rating to prevent permanent set or loss of calibration from continuous overpressurization. Lower pressure range gauges which utilize wide bourdon tube design which inherently would not have the above characteristic shall be furnished with external gauge protectors for overpressure protection.

2.1.9.6 Cases for pressure gauges shall be black phenolic or aluminum with black epoxy paint, with a screwed ring or plastic turret with snap ring to hold the glass in place. Glass shall be shatter resistant type. Cases shall be weatherproof. Blowout protection shall be provided on all process service gauges connected directly to the pressure source. Rupture discs or blowout plugs shall be installed on the lower side of the case for local mounted gauges and on the back for board mounted gauges.

2.1.9.7 Dials shall be painted white, non-rusting metal, with black figures and graduations. Dial faces shall be marked with the words "Steel Tube" or "Stainless Steel Tube." Dial range shall be 0-200 psig.

2.1.9.8 Pointers shall have micrometer adjustment and shall be field adjustable.

2.1.9.9 Accuracy shall be ±1/2 percent of maximum scale.

2.1.10 Sway Bracing

2.1.10.1 The wet pipe sprinkler piping systems shall be supported in accordance with NFPA 13, Section 4-5.4.3. A U Bolt or appropriate guide shall be provided immediately above the stub-up OS&Y valve and secured to the building structure to provide seismic restraint. The Seller shall also be responsible for implementing earthquake design requirements as specified in NFPA 13, Section 4-5.4.3 and UBC Standard 38-1 Seismic Zone 2B, Section 38.104, and FM Data Sheet 2-8.

2.1.11 Fire Alarm Panel

A fire alarm panel shall be provided, installed, and wired in accordance with the requirements of NFPA 70, NFPA 72, NFPA 13, Section 3.1.2 and the Contract Drawings. The panel shall be located in the main entrance area of the Canister Storage Building. The fire alarm panels shall include all of the following features.

2.1.11.1 Local alarms for the automatic sprinkler waterflow pressure switch.

2.1.11.2 Trouble signals for all devices and circuits as required by NFPA 13 and NFPA 72.

2.1.11.3 Emergency battery backup for system operation.

2.1.11.4 Electrical supervision of all circuits as required by NFPA 72.

2.1.11.5 Output contacts and terminals for connection to the Hanford Radio Master Box System, including waterflow alarm, manual fire alarm trouble, and supervisory signals.

2.1.11.6 Initiating device circuits for monitoring the manual fire alarm stations wired in accordance with the Contract Drawings H-2-122746, H-2-122747 and H-2-122748.

2.1.11.7 Supervisory circuits for monitoring the plenum mounted area smoke detector YSH-CSS-015 and the duct mounted smoke detectors, Tag Nos. YSH-CSS-040-1, YSH-CSS-040-2, YSH-CSS-045, and YSH-CSS-009. Reference Specification Section 17697.

2.1.11.8 Power output circuits for supplying 24 volts dc to the smoke detectors shown on the Contract Drawings.

2.1.11.9 All fire alarm panels, detectors, manual fire alarm stations and devices shall be installed and wired in accordance with the manufacturer's instructions and the Contract Drawings H-2-122746, H-2-122747 and H-2-122748.

2.1.11.10 All alarm and trouble conditions shall be annunciated on the front of the control panel, by zone.

2.1.11.11 All fire alarm devices shall include the capability of being uniquely addressed by the control panel.

2.1.11.12 The control panel shall be capable of monitoring and adjusting the sensitivity of all smoke detectors.

2.1.12 Manual Fire Alarm Stations

Manual fire alarm stations, Honeywell Model S464A or equal, shall be provided and mounted in accordance with the manufacturer's instructions and the Contract Drawings. The manual fire alarm stations shall be connected as a supervised loop to the fire alarm panel. The manual fire alarm stations shall be listed by Underwriter's Laboratories, Inc. and installed in accordance with the requirements of NFPA 72.

2.2 **FABRICATION AND MANUFACTURE**

Seller shall furnish all fire protection material and equipment. All materials and equipment furnished in accordance with this specification shall be standard equipment, new, designed for the use intended, and conform to the types and sizes defined in NFPA.

2.3 **SHOP COATING**

Components shall be coated with manufacturer's standard shop coating. Stainless steel parts shall not be coated. Coating shall withstand the environmental conditions described in Paragraph 1.8.

2.4 **LABELING**

2.4.1 All automatic sprinkler equipment shall be provided with an 18 gauge (minimum) stainless steel tag bearing the tag number and a description of the service (stamped or engraved).

2.4.2 Tag shall be permanently affixed to the automatic sprinkler equipment using stainless steel wire where possible, otherwise the use of stainless steel screws or rivets is acceptable. This tag is in addition to any standard nameplate showing manufacturer, model number, etc.

2.5 **CLEANING**

All equipment shall be shipped in a thoroughly clean condition. No sand, oil, grit, grease (except where required for lubrication), weld spatter, or other foreign material shall be present. All openings shall be capped or otherwise sealed with a dust-tight enclosure.

2.6 **INSPECTION AND TESTING**

2.6.1 Wet pipe sprinkler and fire alarm system equipment shall be inspected in accordance with the requirements of NFPA 13, NFPA 72 and Section 1.2.

The Seller shall prepare a construction acceptance test package for Contractor start-up personnel for approval which documents all hand-over package test requirements.

2.6.2 The Seller shall submit the Construction Acceptance Tests/Report verifying that the above requirements have been met. The Buyer shall be notified as a minimum of not less than ten days prior to the date of the test so that he may witness any or all portions necessary.

PART 3 EXECUTION

3.1 PREPARATION

(Not Used)

3.2 INSTALLATION, APPLICATION AND ERECTION

3.2.1 General

Installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with NFPA 13, except as modified herein. Install piping straight and true to bear evenly on hangers and supports. Do not hang piping from plaster ceilings. Keep the interior and ends of new piping and existing piping affected by Seller's operations thoroughly cleaned of water and foreign matter. Keep piping systems clean during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter. The main drain and inspector's test drain shall be piped outside of the building. Seller shall provide all wall sealant materials. Inspect piping before placing into position. All penetrations shall be sealed in accordance with Specification Section 07900 Sealants.

3.2.2 Electrical Work

Provide electrical work associated with this section under Related Document Section 1.3, Specification Section 16100 Electrical Installation and Specification Section 16110 Electrical Materials and Devices. Provide control and fire alarm wiring, including connections to fire alarm systems, under this section in accordance with NFPA 70.

3.2.3 Field Painting

Painting shall be in accordance with Specification Section 09900, Painting.

3.3 FIELD QUALITY CONTROL

The Seller shall be responsible to perform construction acceptance tests to determine compliance with the specified requirements in the presence of the Buyer. Seller shall be responsible for obtaining all approvals, inspection and any and all testing necessary before covering or concealing any piping.

3.4 ADJUSTMENTS

(Not Used)

3.5 **CLEANING**

(Not Used)

3.6 **PROTECTION**

(Not Used)

3.7 **DEMONSTRATION**

(Not Used)

3.8 **SCHEDULES**

(Not Used)

END OF SECTION

U.S. DEPARTMENT OF ENERGY
Hanford Waste Vitrification Plant
Richland, Washington
DOE Contract DE-AC06-86RL10838

FLUOR DANIEL, INC.
Advanced Technology Division
Fluor Contract 8457

SECTION 15760
UNIT HEATERS - ELECTRIC
B-595-C-E350-15760

APPROVED FOR CONSTRUCTION

REVISION 1 PER CR-0859
ISSUE DATE 8/4/93

WAPA YES ___ NO X
QUALITY LEVEL I ___ II X
SAFETY CLASS 1__ 2__ 3 X 4__

ORIGINATOR:

Behzad Entezam 7/8/93
B. Entezam, HVAC Engineer Date

CHECKER:

R. E. Flye 7.8.93
R. E. Flye, HVAC Engineer Date

APPROVED BY:

Manuel G. Mercado 7/14/93
M. G. Mercado Lead Discipline Engineer Date

SECTION 15760
UNIT HEATERS - ELECTRIC
B-595-C-E350-15760

TABLE OF CONTENTS

ATTACHMENTS

SECTION 15760
UNIT HEATERS - ELECTRIC

PART 1 GENERAL

1.1 SUMMARY

This section defines the minimum technical requirements for furnishing, installing and checking out electric unit heaters.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG1	1987 (Rev. 1 - 1989) Standard for Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	1990 National Electrical Code

1.3 RELATED REQUIREMENTS

Specification Section 01730	Operation and Maintenance Data
Specification Section 15196	Identification and Tagging Methods for Mechanical Equipment
Specification Section 16610	Electrical Requirements for Packaged Equipments

1.4 DEFINITIONS

(Not Used)

1.5 SYSTEM DESCRIPTION

(Not Used)

1.6 SUBMITTALS

Submit the following in accordance with the Vendor Drawing and Data Requirements section of the Order/Subcontract.

1.6.1 Literature - Provide descriptive literature and catalog sheets for each piece of equipment and/or component with manufacturer's name, model number(s), shipping weight and operating weight.

1.6.2 Dimensional Outline Drawings - The drawings shall include:

A. Plan views and assembly drawings.

B. Sectional views showing internal arrangement of components.

C. Overall dimensions and interfacing dimensions.

D. Anchoring requirements including mounting brackets, holes size and locations.

E. Electrical and instrumentation connections identified with locations and sizes.

1.6.3 Performance Data - Performance data including tables and curves.

1.6.4 Control Diagrams - Complete control diagrams, wiring diagrams and electrical schematic diagrams with power voltage and amperage ratings.

1.6.5 Parts List and Spare Parts List - A complete parts list and a list of manufacturer's recommended spare parts. Include sufficient information to permit procurement of parts from the manufacturer or any subsupplier.

1.6.6 Installation, Operating, and Maintenance Instructions - Detailed installation, operating, and maintenance instructions shall be submitted in accordance with Specification Section 01730, Operation and Maintenance Data.

1.6.7 Inspection and Checkout List

The Seller shall prepare a checklist for the inspection and checkout of the unit heaters using the format of Attachment B or other form that includes all the information requested in Attachment B. This checklist shall be submitted to the Buyer and shall include the following as a minimum:

A. Equipment is installed in accordance with the manufacturer's recommendations, the drawings, and this specification.

B. Check that unit heater assembly is undamaged, clean and free of foreign material.

C. Check that equipment bearings are lubricated in accordance with manufacturer's recommendations.

D. Check that fan propeller is in alignment and rotates freely.

E. Check unit mounting is fixed.

F. Check that unit internal electrical wiring and controls are undamaged and connections are tight. Check that fuses are installed.

G. Check each unit heater to make sure that the air deflectors are arranged to direct and deliver air to the desired location.

H. Heater current (within nameplate rating).

I. Motor voltage (within nameplate rating).

J. Fan rotation (direction and interference).

K. Check that each unit heater has been properly labeled.

1.6.8 Construction Acceptance Test (CAT) - Inspection and Testing per Paragraph 3.3.1 of this specification.

1.7 **CLASSIFICATION OF SYSTEM AND COMPONENTS**

(Not Used)

1.8 **PROJECT OR SITE ENVIRONMENTAL CONDITIONS**

(Not Used)

PART 2 PRODUCTS

2.1 **MATERIALS AND EQUIPMENT**

2.1.1 General

2.1.1.1 Unit heaters described in this specification and the attached data sheet shall be suitable for vertical and horizontal discharge air distribution. The general arrangement of the unit heaters shall be as shown on the Contract Drawings. Seller shall provide all electrical equipment and materials to form a complete, assembled and wired unit to operate from the single power source.

2.1.1.2 The unit heaters shall be UL listed. All units to have single supply circuit with circuit breakers as required by NEC for element and motor protection. Electrical components and materials shall be in accordance with National Electrical Code (NFPA 70), and in accordance with Paragraph 2.1.2.7 of this specification.

2.1.2 Construction

2.1.2.1 Casing

Unit casing shall be constructed of 22 gauge (minimum) die-formed furniture steel. The casing shall be reinforced for extra strength and rigidity and shall be finished in a durable, baked enamel. For corrosion resistance, all metal parts are to be washed, degreased and phosphatized prior to painting. A hinged panel shall be provided for access to wiring and controls.

2.1.2.2 Heating Elements

Heating elements shall be copper plated steel tubular elements brazed to multiple fins for extra strength and maximum heat dissipation. Fins shall be protected against corrosion by high temperature paint. Heaters shall be rated as specified on the attached data sheet.

2.1.2.3 Fan

Fan shall have a propeller type design with aluminum blades and shall be statically and dynamically balanced. All units shall have a thermal fan delay switch to prevent blowing of unheated air and to remove residual heat from heater cabinet by recirculating ambient air until temperature drop to 90°F for maximum energy savings.

2.1.2.4 Motor

Motor shall be NEMA Standard MG1, totally enclosed, shaded pole or permanent split capacitor, Class "B" insulated and shall be equipped with built-in automatic resetting thermal overload protection. Motors shall be capable of continuous operation in an ambient temperature of 105°F maximum. Motors shall have permanently lubricated bearings. Separate motor supply circuit shall <u>not</u> be required.

2.1.2.5 Louvers

Adjustable louvers shall be provided for horizontal and vertical control of discharge air which shall distribute air flow patterns as indicated on drawings. A standard 45° louvers shall be provided for vertical discharge units.

2.1.2.6 Controls

Controls shall be built-in with the unit heater. Heater control circuit shall include automatic reset thermal cutout switch and an interlocking non-fused disconnect. Built-in controls shall also include; fan relay, control voltage transformer, thermostat (45°-

90°F range), and magnetic control contactor. The thermostat shall be factory preset (field adjustable) at 60 degrees Fahrenheit.

2.1.2.7 Electrical

Unit heater electrical requirements shall be in accordance with Specification Section 16610 and as indicated herein.

2.1.3 Unit Mounting Requirements

2.1.3.1 Wall or Column Mounted Unit Heaters

Wall mounting brackets shall be furnished with provisions for anchoring each unit to its supporting wall or column as shown on the drawings. Wall mounting bracket shall have a minimum of four (4) 9/16-inch bolt holes, with 1/2-inch diameter anchor bolts, nuts and lock washers.

2.1.3.2 Ceiling or Vertical Mounted Unit Heaters

The unit heaters shall be furnished with four (4) 3/8-inch diameter (minimum) hanger rods (with 6-inch threaded ends) of required length. Lock nuts and lock washers shall also be furnished with the hanger rod kits.

2.2 FABRICATION AND MANUFACTURE

(Not Used)

2.3 LABELING

In addition to the manufacturer's identification nameplate, each unit shall be supplied with a corrosion-resistant metal tag identification in accordance with Specification Section 15196, Paragraph 2.2.2.9.

2.4 PACKAGING

Preparation for shipment and packing shall conform to the manufacturer's standards and shall provide protection against corrosion and damage from normal handling. Preparation shall include the following:

2.4.1 Machined surfaces and threads shall be protected during shipment by application of grease or other suitable rust inhibiting compound.

2.4.2 Piping openings to equipment shall be suitably protected to prevent damage to flanges and threads during shipment and storage and shall be plugged or capped to prevent contamination.

2.4.3 Temporary bracing, supports, and rigging connections shall be provided as necessary to prevent damage during shipment, lifting, and unloading.

2.4.4 Separate or loose parts shall be completely boxed and attached to the main equipment and shipped as a unit. All shipping boxes shall be identified with the equipment number(s), Seller's purchase order number, description of the equipment, manufacturer's name, Seller's name, project identification, and destination with ink, paint, or other indelible material. A copy of the packing list shall be securely affixed to the outside of each package or crate.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Before installation, Seller shall review all pertinent documentation and verify the following:

3.1.1.1 All documentation (data and drawings) required by Paragraph 1.6 of this specification has been submitted to the Buyer.

3.1.1.2 The Seller has received from the Buyer approved specification and Contract Drawings covering all equipment and piping to be installed.

3.1.1.3 Inspect each unit to make sure that it is complete with all accessories as specified.

3.1.1.4 Inspect the location on which the units will be installed to make sure that proper power supply is available.

3.1.1.5 Verify that the unit heaters are properly labeled.

3.2 INSTALLATION, APPLICATION AND ERECTION

3.2.1 Install each unit heater in accordance with the manufacturer's instructions, the Contract Drawings and the requirements of this specification.

3.2.2 Mount the unit heater at the location and height as shown on the Contract Drawings.

3.2.3 Direct the air flow from each unit heater so the discharge air does not impinge on any obstacles that may interfere with proper air circulation.

3.2.4 To ensure protection from the environment, the Seller shall paint or coat unit heater casing and accessories with paint to match

manufacturer's prime and finish paint where coating has been disturbed.

3.3 **FIELD QUALITY CONTROL**

3.3.1 Inspection and testing shall be performed as required by field inspection and checkout checklist (Attachment B).

3.4 **ADJUSTMENTS**

(Not Used)

3.5 **CLEANING**

(Not Used)

3.6 **PROTECTION**

(Not Used)

3.7 **DEMONSTRATION**

(Not Used)

3.8 **SCHEDULES**

(Not Used)

END OF SECTION

ATTACHMENT A
DATA SHEET E350-DS-1
UNIT HEATERS - ELECTRIC

PROJ/BLDG : HWVP / CANISTER STORAGE BLDG.
SPEC. NO. : B-595-C-E350-15760
PREPARED BY : B. ENTEZAM BE
CHECKED BY : R. FLYE RF

EQUIPMENT NAME: EQUIPMENT NO.:	MECH RM UNIT HEATER UH-05I-118 THRU 119	OP AREA UNIT HEATER UH-05I-120 THRU 133		
SELECTION:				
MANUFACTURER	*	*		
MODEL NO.	*	*		
QUANTITY REQUIRED	2	14		
PERFORMANCE:				
AIRFLOW, SCFM (min.)	1250	715		
TEMP. RISE, DEG. F	38	44		
SENSIBLE HEAT BTU/HR	51300	34120		
DIRECTION OF AIRFLOW	HORIZONTAL	VERTICAL		
RESISTANCE, IN. W.G.	0.1	0.1		
REQUIRED THROW, FT.	33	20		
POWER:				
KW	15	10		
VOLTS, PHASE, HZ	480/3/60	480/3/60		
CONSTRUCTION:				
SIZE (H X W X D), INCHES	22.5 X 17 X 15.25	18.5 X 14 X 11.50		
CASING MATERIAL	GALV. STEEL	GALV. STEEL		
MOTOR:				
HORSEPOWER	1/4	1/15		
ACCESSORIES:				
THERMOSTAT (BUILT-IN)	YES	YES		
MAGNETIC CONTACTOR	YES	YES		
DIFFUSER	YES	YES		
HIGH TEMP. CUT-OUT	YES	YES		

REMARKS

*Furnished by Equipment Vendor

ATTACHMENT B
FIELD INSPECTION AND CHECKOUT CHECKLIST

UNIT HEATERS - ELECTRIC

Equipment Number _____ Purchase Order No. _____

Location _____

Installed By _____ Mfr. _____

Specification No. _____ Rev. _____ Dwg. No. _____ Rev. _____

NOTES: 1) This checklist covers the general requirements for the inspection and testing of equipment for start-up. It should be used in conjunction with the manufacturer's installation, testing and operating instructions.
2) All test equipment and instrumentation shall be properly calibrated per manufacturer's instructions. Items out of calibration or damaged shall not be used for testing.
3) Record all defects, missing parts, etc., and action taken to correct.

Items to Inspect/Check/Test	Installation Meets Requirements Signature	Recorded Data Remarks
(Inspection/check/test procedures to be detailed in this section. Items should be listed in the order to be accomplished.)		

PROCEDURE APPROVAL — SELLER REPRESENTATIVE _____ DATE _____

PROCEDURE APPROVAL — BUYER'S REPRESENTATIVE _____ DATE _____

TEST COMPLETION ACKNOWLEDGEMENT — SELLER REPRESENTATIVE _____ DATE _____

TEST COMPLETION ACKNOWLEDGEMENT — BUYER'S REPRESENTATIVE _____ DATE _____

U.S. DEPARTMENT OF ENERGY
Hanford Waste Vitrification Plant
Richland, Washington
DOE Contract DE-AC06-86RL10838

FLUOR DANIEL, INC.
Advanced Technology Division
Fluor Contract 8457

SECTION 15771
AIR CONDITIONING UNITS
B-595-C-E350-15771

APPROVED FOR CONSTRUCTION

REVISION 1 PER CR-0859
ISSUE DATE 8/4/93

WAPA YES ___ NO X
QUALITY LEVEL I ___ II X
SAFETY CLASS 1__ 2__ 3 X 4__

ORIGINATOR:

Behzad Entezam 7,8,93
B. Entezam, HVAC Engineer Date

CHECKER:

R. E. Flye 7.8.93
R. E. Flye, HVAC Engineer Date

APPROVED BY:

Manuel G. Mercado Jr 7/14/93
M. G. Mercado Lead Discipline Engineer Date

SECTION 15771
AIR CONDITIONING UNITS
B-595-C-E350-15771

TABLE OF CONTENTS

ATTACHMENTS

SECTION 15771
AIR CONDITIONING UNITS

PART 1 GENERAL

1.1 SUMMARY

This section defines the minimum technical requirements for furnishing, installing, testing and checking out air conditioning units, which include packaged A/C units and split-system units.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 210	1981 Unitary Air Conditioning Equipment
ARI 430	1989 Central Station Air Handling Units
ARI 460	1987 Remote Mechanical Draft Air-Cooled Refrigerant Compressors
ARI 850	1984 Standard for Commercial and Industrial Air Filter Equipment

AIR MOVEMENT AND CONTROL ASSOCIATION, INC. (AMCA)

AMCA Publication 99	1986 Standards Handbook
AMCA Standard 210	1974 Laboratory Methods of Testing Fans for Rating Purposes
AMCA Publication 261	1985 Directory of Products Licensed to Bear the AMCA Certified Rating Seal

AMERICAN NATIONAL STANDARDS INSTITUTE, INC. (ANSI)

ANSI B16.22	1989 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ANSI B31.5	1987 Refrigeration Piping (Addenda B31.5A, 1989; B31.5B, 1991)
ANSI/AFBMA 9	1990 Load Ratings and Fatigue Life for Ball Bearings

AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND AIR-CONDITIONING ENGINEERS, INC. (ASHRAE)

ASHRAE 15	1989 Safety Code for Mechanical Refrigeration
ASHRAE 20	1985 Method of Testing for Rating Remote Draft Mechanical Air-Cooled Refrigerant Condensers
ASHRAE 52	1976 ASHRAE Method of Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME Section IX	1989 Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators (Addenda 1990)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A29/A29M	1991 Standard Specification for Steel Bars, Carbon and Alloy, Hot-Wrought and Cold Finished
ASTM A123	1989 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A307	1990 Standard Specification for Carbon Steel Bolts and Studs, 6000 PSI tensile strength
ASTM A527/A527M	1990 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock-Forming Quality
ASTM A563	1991 Standard Specification for Carbon and Alloy Steel Nuts
ASTM B88	1989 (Rev. A) Standard Specification for Seamless Copper Water Tube
ASTM B75	1986 Standard Specification for Seamless Copper Tube

MANUFACTURERS STANDARDIZATION SOCIETY
OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	1988 Pipe Hangers and Supports - Materials, Design, and Manufacture
MSS SP-69	1983 Pipe Hangers and Supports - Selection and Application

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	1989 Standard for the Installation of Air Conditioning and Ventilation System

UNDERWRITERS LABORATORIES, INC. (UL)

UL 109	1978 Standard for Safety Tube Fittings for Flammable and Combustible Fluids, Refrigeration Service, and Marine Use
UL 723	1983 (R 1987) Surface Burning Characteristic of Building Materials, Sixth Edition
UL 900	1987 Safety Standard for Air Filter Units

1.3 **RELATED REQUIREMENTS**

Specification Section 01730	Operation and Maintenance Data
Specification Section 15196	Identification and Tagging Methods for Mechanical Equipment
Specification Section 15200	Vibration Isolation Devices
Specification Section 15258	Thermal Insulation for Ductwork and Piping
Specification Section 15861	Dampers
Specification Section 15883	Air Filters (HVAC)
Specification Section 16150	Motors - Induction
Specification Section 16610	Electrical Requirements for Packaged Equipment
Specification Section 17864	Instruments Furnished with Mechanical Equipment Canister Storage Building

1.4 **DEFINITIONS**

(Not Used)

1.5 **SYSTEM DESCRIPTION**

(Not Used)

1.6 **SUBMITTALS**

Submit the following in accordance with the Vendor Drawing and Data Requirements section of the Order/Subcontract.

1.6.1 Literatures - Provide descriptive literatures and catalog sheets for each piece of equipment and/or component with manufacturer's name, model number(s), shipping weight and operating weight.

1.6.2 Dimensional Outline Drawings - The drawings shall include:

A. Plan views and assembly drawings.

B. Sectional views showing internal arrangement of components and showing method of removal of coils.

C. Overall dimensions and interfacing dimensions.

D. Location of center of gravity.

E. Mounting holes location and sizes.

F. Size and location of removable lifting lugs.

G. Piping, electrical, and instrumentation connection sizes, types, and locations.

H. Refrigerant piping drawings including pipe sizes.

1.6.3 Performance Data - Performance data including tables and curves.

1.6.4 Electrical and Controls - Complete control diagrams, wiring diagrams, control panel and terminal enclosure detail layout, and electrical schematic diagrams showing voltage and amperage ratings and manufacturer's requirements for equipment protection.

1.6.5 Factory Acceptance Test (FAT) - Test reports in accordance with Paragraph 2.1.2.1.12 of this specification.

1.6.6 Brazing Qualification - Brazing Procedure Specifications (ASME form QB-182 or equivalent) and Procedure Qualification Records (ASME Form QB-483 or equivalent) shall be submitted to Buyer for

approval. They shall be in accordance with the requirements of Section IX of the ASME Code.

1.6.7 Parts List and Spare Parts List - A complete parts list and a list of manufacturer's recommended spare parts. Include sufficient information to permit procurement of parts from the manufacturer or any subsupplier.

1.6.8 Installation, Operating, and Maintenance Instructions - Detailed installation, operating, and maintenance instructions shall be submitted in accordance with Specification Section 01730, Operation and Maintenance Data.

1.6.9 Inspection and Checkout List

The Seller shall prepare a checklist for the inspection and checkout of the air conditioning units using the format of Attachment B or other form that includes all the information requested in Attachment B. This checklist shall be submitted to the Buyer and shall include the following as a minimum:

A. Check that the entire assembly is complete with all components and accessories as specified.

B. Check that equipment is undamaged, clean and free of foreign materials.

C. Check that electrical wiring and instrument piping connections are tight.

D. Check that control instruments and instrument piping are undamaged.

E. Verify that all the material is of the type specified herein.

F. Check that damper assembly is undamaged and moved freely from full open position to close position.

G. Equipment has been properly labeled.

1.6.10 Construction Acceptance Test (CAT)

A. Test results per Paragraph 3.3.1 of this specification.

B. Inspection and testing per Paragraph 3.3.3 of this specification.

1.7 CLASSIFICATION OF SYSTEM AND COMPONENTS

(Not Used)

1.8 PROJECT OR SITE ENVIRONMENTAL CONDITIONS

1.8.1 Climatic and Geographic Site Conditions

A.	Site Elevation	714 feet above sea level
B.	Barometric Pressure	14.3 psia
C.	Outdoor Design Conditions	
1)	Summer Design Temperature	101°F
2)	Winter Design Temperature	9°F
3)	Wet Bulb Design Temperature	68°F

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 General

Each air conditioning unit covered by this specification shall be factory assembled and tested. The units capacity and performance are specified on attached data sheets.

2.1.2 Split-System Units (AH-05I-111 and CU-05I-111)

The air conditioning unit, described in this section, shall be a direct expansion (DX) split-system type, consisting of an indoor air handling unit (AH) and an outdoor air-cooled condensing unit (CU) of the same manufacturer, matched and designed to work together to provide year round heating and cooling function. Provide refrigerant piping and accessories as specified in Paragraph 2.1.2.3 of this specification, and as shown on Contract Drawings.

2.1.2.1 Air Handling Unit (AH-05I-111)

The air handling unit shall be horizontal draw through type with structural housing and base, and shall include fan section, direct expansion (DX) coils, mixing box section, and air filters all arranged as shown on Attachment C. The unit shall be fabricated to the dimensions shown on Attachment C. Unit shall conform to the requirements of ARI 430, AMCA 261 and NFPA 90A.

2.1.2.1.1 Unit Structural Base

A. Unit base shall be constructed on a structural base with main beams and secondary cross members of proper size and type as required to support the unit internal components.

B. The base shall be equipped with anchoring lugs and removable lifting lugs.

C. Provisions shall be made for anchoring unit structural base to the concrete floor with a minimum of 8, equally spaced, 1/2" diameter bolts. Bolt holes shall be 11/16 inch diameter.

2.1.2.1.2 Unit Housing

A. All exterior panels of the housing shall be fabricated from zinc-grip (paint-grip) galvanized steel sheets with a minimum thickness of 16 gauge (0.0635 inch) and a minimum zinc coating of 0.90 ounces per square foot. All sheet metal parts shall be galvanized in accordance with the requirements of ASTM A527-G90. Manufacturer's standard finish shall be provided.

B. The exterior housing panels shall be 24 inches wide and shall be removable. All housing panels shall be of bolted construction using cadmium plated bolts, ASTM A307 and nuts, ASTM A563 at 6 inch intervals installed with cadmium plated washers and neoprene gaskets.

C. Air handling unit shall be provided with drain pan under cooling coil section. Double thickness drain pans with 16 gauge, 304 stainless steel, inner pan and 16 gauge galvanized steel outer liner with insulation between pans. The pans shall have welded corners, cross break and pitch to drain connection.

D. Provide housing with one (1) inch thick, one and one-half (1-1/2) pound density mat-faced fiberglass insulation. Insulation and insulation adhesives shall comply with UL 723.

2.1.2.1.3 Access Doors

A. Air handling unit shall be provided with hinged access doors for access to unit components. Locations and sizes shall be as indicated on Attachment C.

B. Access doors shall be compatible with the housing construction and shall be designed to swing outward as shown on Attachment C.

C. Access doors shall be of double wall construction with insulation in-between. Minimum overall door thickness shall be one inch. Doors shall be equipped with a continuous stainless steel piano hinge or a minimum of three (3) 3 inch x 2 inch butt hinges per door. An omega type neoprene door gasket set within a grooved extrusion in the door frame shall be used to insure tight closure.

D. Doors shall be equipped with a minimum of three (3) latches. Latches shall be constructed such that doors can be opened from either the outside or the inside of the plenum. Latches shall be Type SP-20 as manufactured by Duro Dyne Corporation, or equal.

E. Bolted access panels to match the unit housing for coil removal shall be provided.

2.1.2.1.4 Fan

A. Supply fan shall be centrifugal double width, double inlet type with a single wheel construction in accordance with AMCA Standard 99. The fan shall be rated in accordance with AMCA Standard 210 and ratings corrected for the effect of housing enclosure. Fan shall be electric motor driven through a V-belt system. Both fan and motor shall be mounted on a steel vibration isolator base inside the housing as described in Paragraph 2.1.2.1.9 of this specification. Certified fan ratings shall be submitted to the Buyer for review and approval.

B. The fan housing and scroll shall be steel fabricated construction, welded, stiffened and braced as necessary to prevent flow-induced flutter, and vibration. Fan discharge shall be provided with internally mounted flexible connection. The discharge opening shall be rectangular and shall have a flanged connection.

C. The fan shall have forward-curved blades of bonderized steel painted with baked enamel, or galvanized steel. Fan wheel shall be keyed to the shaft and shall be designed for continuous operation at the maximum rated fan speed and motor horsepower. Fan wheel assembly shall be statically and dynamically balanced and shall not exceed the vibration level specified under Paragraph 2.1.2.1.12 of this specification.

D. Fan shaft shall be constructed of ASTM A29 Grade 1040 or 1045 hot-rolled steel accurately turned, ground and polished. Shaft shall be of solid construction. The fan shaft/wheel assembly shall be designed such that the first

critical speed shall be at least 25 percent greater than the fan design speed. Ends shall be centered for RPM counters.

E. Bearings shall be grease lubricated, self-aligning, antifriction pillow block type ball bearings designed for a L-10 life of 120,000 hours at maximum operating conditions in accordance with ANSI/AFBMA 9. Fan bearings shall have grease leads extended to an accessible point outside of unit housing for central lubrication through a grease fitting.s Lubrication instructions shall be provided near the grease fitting by means of a stamped metal plate. Bearings shall be as manufactured by SKF, or equal.

F. The drive transmission shall be of the multiple V-belt type. V-belt drives shall be sized for at least 150 percent of the drive motor nameplate horsepower. Drives shall have adjustable pitch drive pulleys. V-belts shall be provided in matched sets. One extra set of V-belts shall be shipped to the Buyer with each unit.

2.1.2.1.5 Motor

A. Fan driver motor shall be provided in accordance with Specification Section 16150, and as indicated herein.

B. Motor shall be provided with an adjustable base and shall be mounted on the fan vibration isolation base. Adjustment shall be adequate to provide for replacement of belts, proper alignment, and belt tension adjustment.

C. Motor grease fittings shall be accessible outside the plenum. Where required, extended grease lines with grease fittings shall be provided.

D. Fan motor name plate shall be a minimum of 20 percent greater than the maximum fan brake horsepower at the rated speed.

2.1.2.1.6 Refrigerant (DX) Cooling Coil

A. Casing shall be constructed of 16 gauge galvanized steel with extruded tube holes. Reinforced flanges will be provided for added strength and to facilitate stacking. Coils having a finned length over 79 inches shall have intermediate tubes support.

B. Headers shall be of seamless copper tubing. The headers shall have extruded tube holes to provide a large brazing surface to maximum strength. Copper supply and return connections shall be provided as standard.

C. Primary surface shall be seamless 1/2 inch O.D. copper tube. All connections shall be brazed using high silver content brazing rods.

D. Secondary surface shall consist of corrugated aluminum plate fins for higher capacity and structural strength. Fins shall have full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Tubes shall be mechanically expanded into the fins to provide a continuous primary to secondary bond over the entire finned length. The use of solder to bond fins to tubing is not acceptable.

E. Evaporator coils shall be tested at 400 psig air pressure while under warm water and shall be suitable for 250 psig working pressure. Coils shall be dehydrated, nitrogenized and capped to prevent contamination while in transit or storage. All coils shall have uniform circuits and shall be circuited in a counterflow manner.

F. Liquid distributors shall be factory furnished and mounted.

2.1.2.1.7 Air Filter Section

Air handling unit shall be provided with air filters of the type, efficiency and arrangement as shown on Attachment C and as indicated on the attached data sheets. Air filter section shall allow for convenient replacement and inspection. Air filters shall be "Type I" and "Type IIA" as provided in accordance with Specification Section 15883. Filters shall comply with ARI-850. Filter gages shall be provided in accordance with Specification Section 17864. One extra set of air filters shall be shipped to the Buyer with each unit.

2.1.2.1.8 Mixing Box

Provide mixing box with flanged connections to match the basic unit. Air intake openings shall be sized to individually handle the unit full air flow capacity. Arrange openings as indicated on Attachment C. Provide openings with dampers of opposed blade type. Connect damper shafts together by one continuous linkage bar. Arrange dampers for automatic operation so that when one starts to close from its opened position, the other starts to open from its closed position. Dampers shall be "Automatic Dampers - Type I", with pneumatic actuators as provided in accordance with Specification Section 15861. Damper actuators shall be externally mounted.

2.1.2.1.9 Vibration Isolators

The fan and motor shall be mounted on a common vibration isolation base inside the air handling unit housing. The base shall be manufactured of minimum 4 inch structural main members. Secondary cross members shall be of the size and type required to support the fan and motor. The vibration isolator shall be "Spring Type" as provided in accordance with Specification Section 15200.

2.1.2.1.10 Controls and Instrumentation

Unit associated controls and instrumentation, and the instrument rack shall be furnished and supplied with the air handling unit. The instrument rack, controls and instrumentation shall be provided in accordance with Specification Section 17864.

2.1.2.1.11 Electrical Requirements

The air handling unit electrical requirements shall be in accordance with Specification Section 16610.

2.1.2.1.12 Factory Acceptance Test

A. The air handling unit shall be inspected, operated and factory run tested for vibration prior to shipment from the factory.

B. The vibration tests shall be performed on each fan with each motor to assure that the amplitude of vibration (displacement in mils), at operating speed measured at each unit fan bearing and motor bearing shall not exceed the value interpolated from the following table:

Fan or Motor RPM	500	800	1100	1400	1700	2100	
mils (peak to peak)	4.2	3.0	2.3	1.9	1.6	1.3	(in each plane)

C. Inspection and vibration test procedures, and test results shall be documented and shall be included in the submittal requirements of this specification.

D. Test records shall contain the following information as a minimum:

1) Unit tested
2) Date of test
3) Equipment, instrumentation and data recorder used
4) Type of observation
5) Results and acceptability
6) Action taken in connection with any deviations noted, if any

7) Name(s) and title of person(s) evaluating test results.

E. Test results shall be evaluated by a responsible authority (Seller) to assure that test requirements are satisfied. Test results shall be submitted to the Buyer for review and approval.

2.1.2.2 Air-Cooled Condensing Unit (CU-05I-111)

2.1.2.2.1 General

A. Unit shall meet the standards, rating and testing requirement of ARI 460 and ASHRAE Standard 20. Unit shall be UL listed and shall conform to Safety Standard, ASHRAE 15.

B. Electrical requirements shall conform or shall be in accordance with Specification Section 16610.

2.1.2.2.2 Casing

Casing shall be designed to provide weather-proof protection suitable for outdoor installation. Casing to be constructed of galvanized steel, zinc phosphated and finished with baked enamel. Openings shall be provided for electrical power and piping connections as well as removable panels for service access.

2.1.2.2.3 Coils

Condenser coils shall be nonferrous construction with aluminum plate fins mechanically bonded to seamless copper tubes. Coils shall be circulated for sub-cooling.

2.1.2.2.4 Fan

Condenser fan shall be direct drive propeller type with vertical discharge. Totally enclosed fan cooled (TEFC) motor shall have inherent thermal and current protection with permanent lubrication and isolation mounting. Fan to be provided with safety guards and cycling controls for reduced capacity operation. Motors shall be in compliance with MG1 standard.

2.1.2.2.5 Compressor

Compressor shall be the hermetic type with external spring isolators and an automatically reversible oil pump. Compressor to be located in a dedicated compartment separated from the fan/coil section. Provide crankcase heater and cut-off switch for each compressor.

2.1.2.2.6 Refrigeration Section

Unit refrigeration control shall include suction and liquid line service valves with pressure taps and charging connections.

2.1.2.2.7 Controls

Controls shall be factory wired and located in a separate terminal enclosure. Enclosure shall be a NEMA 4X enclosure in accordance with NEMA 250. Safety controls shall consist of a compressor anti-cycle timer, motor overloads and high and low pressure cut-outs. Manufacturer shall provide a reduced voltage transformer to serve the control circuit. Provide low head pressure control to allow system operation at light load conditions and at ambient temperature down to minus twenty degrees Fahrenheit. Damper control is not acceptable.

2.1.2.2.8 Frame Support Legs

Provide a three (3) feet high structural rigid frame with support legs (minimum L3" x 3" x 3/8" thick) for snow build-up protection. Unit frame support shall be provided with corrosion resistant paint with finish to match the condensing unit. The unit shall be mounted to the frame with a minimum of six (6) 3/8 inch diameter bolts. Provision for anchoring the frame support to a concrete pad with a minimum of four (4) 1/2 inch diameter anchor bolts shall be provided. See unit configuration layout on Page 2 of Attachment C.

2.1.2.3 Refrigerant Piping and Accessories

2.1.2.3.1 General

Material and dimensional requirements for field-assembled refrigerant piping, valves, fittings and accessories shall conform to ASHRAE 15 and ANSI B31.5, except as herein specified.

2.1.2.3.2 Piping

Provide seamless copper tubing, hard-drawn, Type K or L, conforming to ASTM B88, except that piping with outside diameters of 1/4 inch and 3/8 inch shall have nominal wall thickness of not less than 0.025 inch and 0.032 inch, respectively. Soft annealed copper tubing conforming to ASTM B75 may be used where flare connections to equipment are required only in nominal sizes less than one inch outside diameter.

2.1.2.3.3 Fittings

ANSI B16.22 for solder-joint fittings. UL 109 for flared tube fittings.

2.1.2.3.4 Accessories

Strainer, filter-drier, service valves, and sight glass with moisture indicator shall be furnished and factory installed in the unit.

2.1.2.3.5 Refrigerant Piping Insulation

Refrigerant piping insulation shall be provided in accordance with Specification Section 15258.

2.1.3 Packaged Air Conditioning Units (AC-05I-110A & 110B)

The air conditioning units described in this section shall be a mini-computer-room module unit, direct expansion (DX) refrigeration system consisting of compressor, evaporator coil, condenser coil, externally equalized thermal expansion valve, refrigerant system components, direct drive blower(s), motor(s), humidifier, internal wiring and electrical devices and all necessary temperature and humidity controls. The unit shall be fabricated with the capacitors, compressor and service valves, start relay, sight glass, and pressure switches located out of the process air stream, so that system operation can be checked while the unit is operating. The units shall be designed suitable for ceiling installation as shown on Contract Drawings.

2.1.3.1 Cabinet

The cabinet shall be fabricated of minimum of 20 gauge hot rolled steel casing complete with removable access panels and top. The entire cabinet shall be lined with 1", 1-1/2 lb. density neoprene coated fiberglass acoustic and thermal insulation. The cabinet shall be provided with a primary condensate pan of 304-L stainless steel located beneath the cooling coil and a secondary safety containment pan which serves as the unit bottom. Manufacturer's standard finish shall be provided.

2.1.3.2 Compressors

All compressors shall be of the welded hermetic design, suction cooled and shall have full pressure lubrication, oil return check valves, suction and oil strainers, suction and discharge shut-off valves and automatic reversible oil pump. The compressor shall be equipped with an anti-short cycle time delay circuit to prevent short cycling of compressor motor. High and low pressure safety controls shall be provided. The compressor speed shall be 3500 rpm.

2.1.3.3 Cooling/Condenser Coil

The coils shall be constructed of die formed corrugated aluminum fins mechanically bonded to 0.375" diameter seamless copper tubes.

2.1.3.4 Air-Cooled Condenser

A complete factory assembled and precharged unit with an integral condenser coil and centrifugal blower suitable for connection to field supplied ductwork that utilizes outside air for the removal system heat.

2.1.3.5 Blowers

Both the supply air and condenser blowers shall be double width double inlet (DWDI) direct drive forward curve design with galvanized steel scroll, permanently sealed and lubricated ball bearings and statically and dynamically balanced. The blower(s) shall be draw-through configuration. The wheels shall be of galvanized steel construction.

2.1.3.6 Blower Motors

Blower motor(s) shall be open drip proof permanent split capacitor supported by steel spider and ring mount hardware to the blower scroll. The motor(s) shall be dynamically balanced with ball bearings, automatic reset thermal overloads, Class B insulation and 1.15 service factor.

2.1.3.7 Humidifier

The humidifier shall be located downstream of the cooling coil and shall consist of electronic steam generator with replaceable cylinder and automatic current sensing system to adjust current flow to electrodes for varying water levels.

2.1.3.8 Refrigeration Components

The evaporator circuit shall be provided with externally equalized thermal expansion valve, filter drier, and sight glass. The compressor shall be equipped with crankcase heater.

2.1.3.9 Controls

2.1.3.9.1 A remote mounting type Unit Indicator Controller (UIC) shall be furnished with the unit and shall be provided in accordance with Specification Section 17864.

2.1.3.9.2 Contactors, relays, time delays and transformers shall be furnished with the unit.

2.1.3.10 A factory installed low ambient control valve shall be provided for winter ambient temperature of 12°F.

2.1.3.11 Filters

Disposable filters shall be provided and shall consist of extended surface pleated media of non-woven surface cotton fiber. The filter shall be rated at 35% N.B.S. atmospheric dust test and 90% arrestance using ASHRAE 52-76 test method. One extra set of air filters shall be shipped to the Buyer with each unit.

2.1.3.12 Electrical

Electrical requirements shall be in accordance with Specification Section 16610.

2.1.3.13 Anchorage Requirements

Provide unit base support frame with a minimum of four (4) 9/16 inch diameter mounting holes.

2.1.3.14 Unit shall be Pomona Air, Flex-Cool units Model FCA 200 or equal.

2.2 **FABRICATION AND MANUFACTURE**

(Not Used)

2.3 **LABELING**

In addition to the manufacturer's identification nameplate, each unit shall be supplied with corrosion-resistant metal tag identification in accordance with Specification Section 15196, Paragraph 2.2.2.9.

2.4 **PACKAGING**

Preparation for shipment and packing shall conform to the manufacturer's standards and shall provide protection against corrosion and damage from normal handling. Preparation shall include the following:

2.4.1 Machined surfaces and threads shall be protected during shipment by application of grease or other suitable rust inhibiting compound.

2.4.2 Piping openings to equipment shall be suitably protected to prevent damage during shipment and the openings shall be plugged or capped to prevent contamination.

2.4.3 Temporary bracing, supports, and rigging connections shall be provided as necessary to prevent damage during shipment, lifting, and unloading.

2.4.4 Separate or loose parts shall be completely boxed and attached to the main equipment and shipped as a unit. All shipping boxes shall be identified with the equipment number(s), Seller's purchase order number, description of the equipment, manufacturer's name, Seller's name, project identification, and destination with ink, paint, or other indelible material. A copy of the packing list shall be securely affixed to the outside of each package or crate.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Before installation, Seller shall review all pertinent documentation and verify the following:

3.1.1.1 All documentation (data and drawings) required by Paragraph 1.6 of this specification has been submitted to the Buyer.

3.1.1.2 The Seller has received from the Buyer approved specifications and Contract Drawings covering all equipment and piping to be installed.

3.1.1.3 Inspect each unit to make sure that it is complete with all accessories as specified.

3.1.1.4 Inspect the foundation or pad on which the units will be installed to make sure it is of the size required.

3.1.1.5 Verify that the components carry the required certifications in accordance with Paragraph 2.1 of this specification.

3.2 INSTALLATION, APPLICATION AND ERECTION

3.2.1 Air Conditioning Units

3.2.1.1 Install each unit in accordance with the manufacturer's instructions, this specification and the Contract Drawings.

3.2.1.2 AH-05I-111 Unit

Install air handling unit and instrument rack on concrete pad at location shown on the Contract Drawings.

3.2.1.3 CU-05I-111 Unit

Install air-cooled condensing unit mounted on structural support frame at location shown on the Contract Drawings.

3.2.1.4 AC-05I-110A & AC-05I-110B Units

Install each air conditioning unit as shown on the Contract Drawings.

3.2.1.5 Provide touch-up to match factory applied finish if coatings have been scratched or disturbed.

3.2.1.6 Provide and install condensate drain trap and drain lines as indicated on the Contract Drawings.

3.2.2 Refrigerant Piping (AH-05I-111 & CU-05I-111 Units)

3.2.2.1 Bending, forming and assembly of refrigerant piping shall conform to ANSI B31.5.

A. Pipe Hangers and Supports

Fabrication of pipe hangers, supports, and welding attachments shall conform to MSS SP58. Installation of hanger types and supports for bare and covered pipes shall conform to MSS SP69 for the system temperature range. Unless otherwise indicated, horizontal and vertical piping attachments shall conform to MSS SP58.

B. Refrigerant Piping

1. Install interconnecting refrigerant piping as shown on the Contract Drawings.

Cut pipe to sizes shown on the Contract Drawings to measurements established at the site and work into place without springing or forcing. Install piping to provide for expansion and contraction due to temperature fluctuation. Where pipe passes through building structure pipe joints shall not be concealed, but shall be located where they may be readily inspected. Installed piping shall be insulated with sufficient clearance to permit application of insulation. Install piping as indicated and detailed, to avoid interference with other piping, conduit, or equipment. Except where specifically indicated otherwise, run piping straight and parallel to walls and ceilings. Trapping of lines will not be permitted except where indicated. Provide sleeves of suitable size for lines passing through building structure.

2. Brazing of refrigerant piping shall be in accordance with ANSI B31.5 Paragraph 528 as indicated herein. Inside of tubing and fittings shall be free of flux. Clean parts to be jointed with emery cloth and kept hot until solder has penetrated full depth of fitting and extra flux has been expelled. Cool joints in air and remove flame marks and traces of flux. During brazing operation, prevent oxide film from forming on inside of tubing by slowly flowing dry nitrogen through tubing to expel air.

   Inspection and testing of brazed joints shall be in accordance with ANSI B31.5 Paragraph 536.

C. Refrigerant Insulation

Insulation shall not be installed to system piping until they have been leak tested and approved. Insulation shall be provided in accordance with Specification Section 15258.

3.3 **FIELD QUALITY CONTROL**

3.3.1 Leak Testing

3.3.1.1 Upon completion of installation of air conditioning equipment, factory and field-installed refrigerant piping shall be tested for leaks with an electronic-type leak detector. Use same type of refrigerant to be provided in the system for leak testing. When nitrogen is used to boost system pressure for testing, ensure that it is eliminated from the system before charging. Minimum refrigerant leak field test pressure shall be as specified in ANSI 15, except that test pressure shall not exceed 150 psig on hermetic compressors unless otherwise specified as a low side test pressure on the equipment nameplate. If leaks are detected at time of installation or during warranty period, remove the entire refrigerant charge from the system, correct leaks and retest system.

3.3.1.2 Test results shall be documented and evaluated by a responsible authority (Seller) to assure that test requirements have been satisfied. Test documents shall be included in the submittal requirements of this specification.

3.3.1.3 Test records shall contain the information as required per Paragraph 2.1.2.1.12D of this specification.

3.3.1.4 Test results shall be evaluated by a responsible authority (Seller) to assure that test requirements are satisfied. Test results shall be submitted to the Buyer for review and approval.

3.3.2 Evacuation, Dehydration and Charging.

After field charged refrigerant system is found to be without leaks or after leaks have been repaired on field-charged and factory-charged systems, evacuate the system using a reliable gauge and a vacuum pump capable of pulling a vacuum of at least one mm Hg absolute. Evacuate and dehydrate system in accordance with equipment manufacturer's printed instructions. Charge system in accordance with manufacturer's recommended pressure with the refrigerant type as indicated on the data sheet.

3.3.3 Inspection and testing shall be performed as required by field inspection and checkout checklist (Attachment B).

3.4 **ADJUSTMENTS**

(Not Used)

3.5 **CLEANING**

(Not Used)

3.6 **PROTECTION**

(Not Used)

3.7 **DEMONSTRATION**

(Not Used)

3.8 **SCHEDULES**

(Not Used)

END OF SECTION

ATTACHMENT A
DATA SHEET E350-DS-1
AIR HANDLING UNITS

PROJ/BLDG : HWVP / CANISTER STORAGE BLDG.
SPEC. NO. : B-595-C-E350-15771
PREPARED BY : B. ENTEZAM B.E.
CHECKED BY : R. FLYE RF

EQUIPMENT NAME: OFFICE AREA AHU
EQUIPMENT NO.: AH-05I-111

SELECTION:		EVAPORATIVE COIL: (C0-05I-111)		
MANUFACTURER	*	QUANTITY	1	
MODEL NO.	*	FACE AREA, SQ. FT. (min.)	3.63	
QUANTITY REQUIRED	1	FACE VELOCITY, FPM (max.)	500	
HORIZONTAL OR VERTICAL	HORIZONTAL	NO. OF ROWS / FINS PER INCH	*	
LOW, MEDIUM OR HIGH PRESSURE	MEDIUM	COOLING RATING:		
REFRIGERANT	R 22	TOTAL CAPACITY, BTUH (min.)	63200	
POWER, VOLTS/PHASE/HZ	460/3/60	ENTERING CONDITIONS, DB/WB F	86 / 64	
FAN: (BL-05I-111)		FILTERS:		
AIRFLOW, SCFM (min.)	1900	ARRANGEMENT	FLAT	FLAT
TOTAL S.P., IN. W.G.	4	MEDIA VELOCITY, FPM (max.)	500	500
RPM	*	NBS EFFICIENCY RATING	30%	95%
BAROMETRIC PRESSURE, IN. HG.	29.16	CLEAN PRESSURE DROP, IN. W.G.	0.3	0.65
NOMINAL WHEEL DIA., IN.	*	MAX. PRESSURE DROP, IN. W.G.	1.0	1.2
DISCHARGE POSITION	UP BLAST	TYPE	I	IIA
WHEEL TYPE	CENTRIFUGAL	ACCESSORIES:		
		ADJUSTABLE MOUNTING BASE	YES	
		VIBRATION ISOLATION	SPRING TYPE	
		MIXING BOX	YES	
MOTOR: (MT-05I-111)		CONTROLS	SEE SPEC.	
H.P. (max.)	3			
VOLTS, PHASE, HZ	460/3/60			
ENCLOSURE	OPEN DRIP PROOF	MAXIMUM EQUIPMENT ENVELOPE	SEE ATTACHMENT C	
DRIVE TYPE	V BELT			
SERVICE FACTOR	1.15			
MOTOR SHEAVE	FIXED			
TOTAL UNIT OPERATING WEIGHT	*			

REMARKS:

*FURNISHED BY EQUIPMENT VENDOR

ATTACHMENT A
DATA SHEET E350-DS-2
AIR COOLED CONDENSING UNIT

PROJ/BLDG : HWVP / CANISTER STORAGE BLDG.
SPEC. NO. : B-595-C-E350-15771
PREPARED BY : B. ENTEZAM BE.
CHECKED BY : R. FLYE RF

EQUIPMENT NAME: OFFICE AREA AHU CONDENSING UNIT
EQUIPMENT NO.: CU-05I-111

SELECTION:		ACCESSORIES:	
MANUFACTURER	*	LOW AMBIENT CONTROL	YES
MODEL NO.	*	LOW TEMP. LIMIT, F (min.)	-20
QUANTITY REQUIRED	1	STRUCTURAL FRAME SUPPORT LEGS, FEET	3 (SEE SPEC.)
PERFORMANCE:		TOTAL UNIT WEIGHT, LBS	1500
NET CLNG CAPACITY, BTUH (min.)	63200	TOTAL POWER REQUIRED	9.4 kW
SATURATED SUCTION TEMP. F	45		
CONDENSER ENT. AIR TEMP (DB)	101		
		MAXIMUM EQUIPMENT ENVELOPE	SEE ATTACHMENT C
SATURATED COND. TEMP. DEG. F	*		
COMPRESSOR MOTOR HP	2		
ELECTRICAL CHARACTERISTICS:			
POWER: VOLTS, PHASE, HERTZ	460/3/60		
CONTROL: VOLTS, PHASE, HERTZ	24/1/60		
COMPRESSOR:			
QUANTITY	1		
HERMETIC OR SERVICEABLE HERMETIC	HERMETIC		
POWER REQUIRED, (max.)	12.1 RLA		
CONDENSER COIL:			
ROWS	*		
TUBE MATERIAL	COPPER		
FIN MATERIAL	ALUMINUM		
FINS PER INCH	*		
CONDENSER FANS:			
QUANTITY	*		
HORSE POWER, (max.)	1/2		

REMARKS:

*FURNISHED BY EQUIPMENT VENDOR

ATTACHMENT A
DATA SHEET E350-DS-3
AIR CONDITIONING UNITS

PROJ/BLDG : HWVP / CANISTER STORAGE BLDG.
SPEC. NO : B-595-C-E350-15771
PREPARED BY : B. ENTEZAM B.E.
CHECKED BY : R. FLYE RF

EQUIPMENT NAME: FOS #5 A/C UNITS
EQUIPMENT NO.: AC-05I-110A & AC-05I-110B

SELECTION:		EVAPORATOR FAN:	
MANUFACTURER	*	AIR FLOW, SCFM (min.)	1000
MODEL NO.	*	NO. OF FANS	1
QUANTITY	2 (one standby)	EXTERNAL S.P., IN. W.G.	0.5
UNIT STYLE	*	WHEEL TYPE	CENTRIFUGAL
RATING:		SPEED, RPM (max.)	*
TOTAL CAPACITY, BTUH (min.)	23400	HUMIDIFIER: HU-05I-110A & 110B	
SENSIBLE CAPACITY, BTUH (min.)	21200	TYPE	SELF GENERATED STEAM
POWER, VOLTS/PHASE/HZ	277/1/60	CAPACITY, LBS/HR (min.)	5
ENTERING CONDITION, DB/WB F	72/60 F		
REFRIGERANT	R-22	CONDENSER SECTION: (CU-05I-110A & 110B)	
		COIL:	
COMPRESSOR:		QUANTITY	1 (EACH UNIT)
QUANTITY	1 (EACH UNIT)	FACE AREA, SQ. FT. (min.)	2
OPEN OR HERMETIC	HERMETIC	FACE VELOCITY, FPM (min.)	700
INTERNAL SPRING ISOLATION	YES	TUBE MATERIAL	COPPER
		FIN MATERIAL	ALUMINUM
EVAPORATOR COIL SECTION: C0-05I-110A & 110B		FIN MOUNTING METHOD	MECH. BONDED
QUANTITY	1 (EACH UNIT)	FAN: BL-05I-210A & 210B	
FACE AREA, SQ. FT. (min.)	2	AIR FLOW, SCFM	1400
FACE VELOCITY, FPM (max.)	525	NO. OF FANS	1
TUBE MATERIAL	COPPER	EXTERNAL STATIC PRESSURE, IN. W.G.	0.5
NO. OF ROWS / FINS PER INCH	*	WHEEL TYPE	CENTRIFUGAL
FIN MATERIAL	ALUMINUM	DRIVE	DIRECT
FIN MOUNTING METHOD	MECH. BONDED	ACCESSORIES:	
		CONTROLS	SEE SPEC.
TOTAL OPERATING UNIT WT, (lbs)	*		
TOTAL POWER REQUIRED (max.)	29 FLA	MAXIMUM EQUIPMENT ENVELOPE, INCH	62"L X 46"W X 24"H

REMARKS:

*FURNISHED BY EQUIPMENT VENDOR

ATTACHMENT B
FIELD INSPECTION AND CHECKOUT CHECKLIST
AIR CONDITIONING UNITS

Equipment Number _____ Purchase Order No. _____

Location _____

Installed By _____ Mfr. _____

Specification No. _____ Rev. _____ Dwg. No. _____ Rev. _____

NOTES: 1) This checklist covers the general requirements for the inspection and testing of equipment for start-up. It should be used in conjunction with the manufacturer's installation, testing and operating instructions.
2) All test equipment and instrumentation shall be properly calibrated per manufacturer's instructions. Items out of calibration or damaged shall not be used for testing.
3) Record all defects, missing parts, etc., and action taken to correct.

Items to Inspect/Check/Test	Installation Meets Requirements Signature	Recorded Data Remarks
(Inspection/check/test procedures to be detailed in this section. Items should be listed in the order to be accomplished.)		

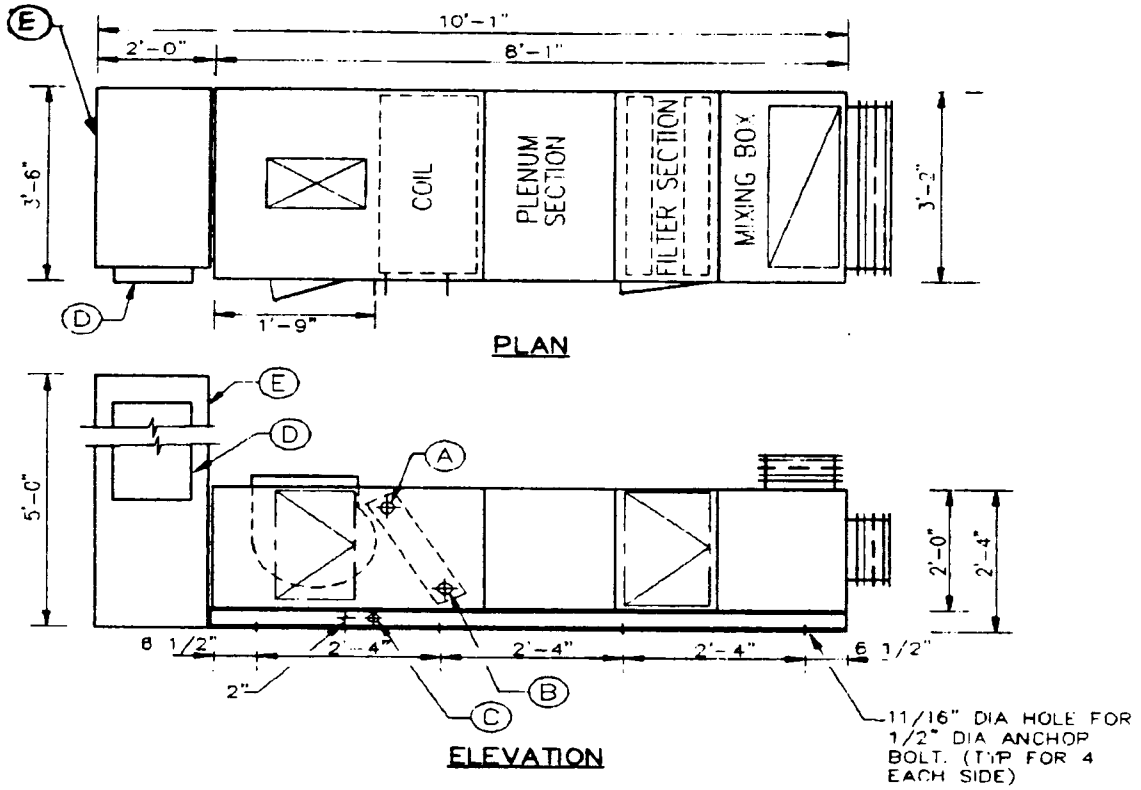
PROCEDURE APPROVAL — SELLER REPRESENTATIVE _____ DATE _____

BUYER'S REPRESENTATIVE _____ DATE _____

TEST COMPLETION ACKNOWLEDGEMENT — SELLER REPRESENTATIVE _____ DATE _____

BUYER'S REPRESENTATIVE _____ DATE _____

ATTACHMENT C
UNIT CONFIGURATION LAYOUT
AIR HANDLING UNIT



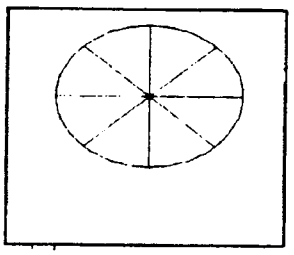
LEGEND

- (A) LIQUID LINE (HVAC)
- (B) SUCTION LINE (HVAC)
- (C) 3/4" PLAIN END CONDENSATE LINE
- (D) TERMINAL BOX
- (E) INSTRUMENT RACK

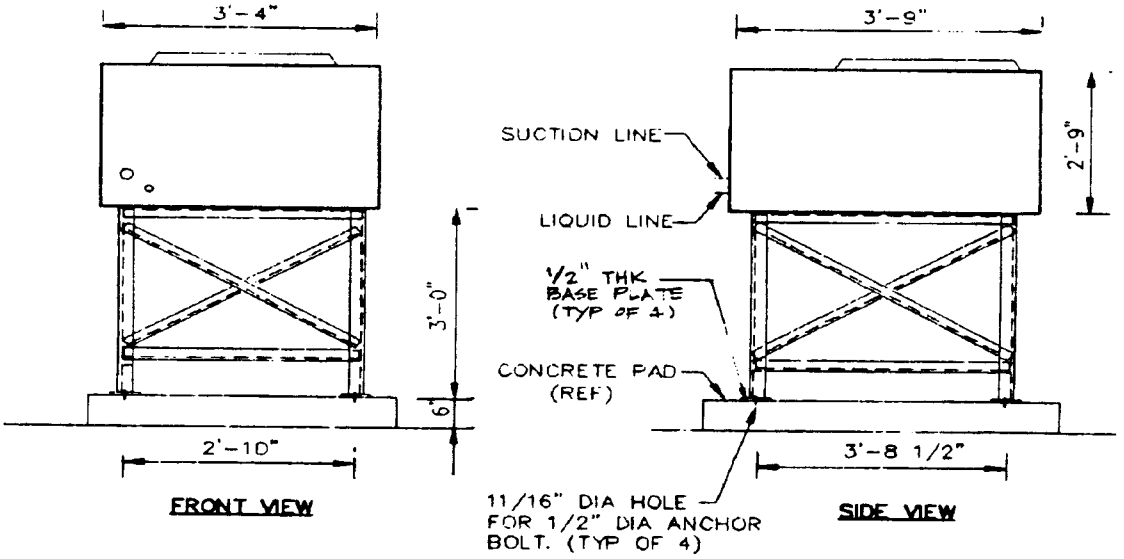
NOTE: MAXIMUM EQUIPMENT ENVELOPE = 10'-2"L X 3'-6" W X 5'-0"H

AH-05I-111

ATTACHMENT C
UNIT CONFIGURATION LAYOUT
AIR COOLED CONDENSING UNIT



TOP VIEW



NOTE: MAXIMUM EQUIPMENT ENVELOPE = 4'-0"L X 3'-6" W X 3'-0"H

CU-05I-111

U.S. DEPARTMENT OF ENERGY
Hanford Waste Vitrification Plant
Richland, Washington
DOE Contract DE-AC06-86RL10838

FLUOR DANIEL, INC.
Advanced Technology Division
Fluor Contract 8457

SECTION 15782
AIR HANDLING UNITS
(EVAPORATIVE COOLER TYPE)
B-595-C-E350-15782

APPROVED FOR CONSTRUCTION

REVISION 1 PER CR-0859
ISSUE DATE 8/4/93

WAPA YES ___ NO X
QUALITY LEVEL I ___ II X
SAFETY CLASS 1__ 2__ 3X 4__

ORIGINATOR:

Behzad Entezam 7,8,93
B. Entezam, HVAC Engineer Date

CHECKER:

R. E. Flye 7.8.93
R. E. Flye, HVAC Engineer Date

APPROVED BY:

Manuel G. Mercado 7/14/93
M. G. Mercado Lead Discipline Engineer Date

SECTION 15782
AIR HANDLING UNITS
(EVAPORATIVE COOLER TYPE)
B-595-C-E350-15782

TABLE OF CONTENTS

ATTACHMENTS

SECTION 15782
AIR HANDLING UNITS
(EVAPORATIVE COOLER TYPE)

PART 1 GENERAL

1.1 SUMMARY

This section defines the minimum technical requirements for furnishing, installing, testing and checking out air handling (evaporative cooler type) units.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 430	1989 Central Station Air Handling Units
ARI 850	1984 Standard for Commercial and Industrial Air Filter Equipment

AIR MOVEMENT AND CONTROL ASSOCIATION, INC. (AMCA)

AMCA Publication 99	1986 Standards Handbook
AMCA Standard 210	1974 Laboratory Test Methods of Testing Fans for Rating Purposes
AMCA Publication 261	1985 Directory of Products Licensed to Bear the AMCA Certified Rating Seal

AMERICAN NATIONAL STANDARDS INSTITUTE, INC. (ANSI)

ANSI/AFBMA 9	1990 Load Ratings and Fatigue Life for Ball Bearings

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A29/A29M	1991 Steel Bars, Carbon and Alloy, Hot-Wrought and Cold Finished
ASTM A123	1989 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A307	1990 Standard Specification for Carbon Steel Bolts and Studs, 6000 PSI Tensile Strength
ASTM A312/A312M	1991 Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipe
ASTM A527/A527M	1990 Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock-Forming and Quality
ASTM A563	1991 Standard Specification for Carbon and Alloy Steel Nuts

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	1989 Standard for the Installation of Air Conditioning and Ventilation System

UNDERWRITERS LABORATORIES, INC. (UL)

UL 723	1983 (R 1987) Surface Burning Characteristic of Building Materials, Sixth Edition
UL 778	1991 Standard for Motor-Operated Water Pumps
UL 900	1987 Safety Standard for Air Filter Units

1.3 **RELATED REQUIREMENTS**

Specification Section 01730	Operation and Maintenance Data
Specification Section 15196	Identification and Tagging Methods for Mechanical Equipment
Specification Section 15200	Vibration Isolation Devices
Specification Section 15861	Dampers
Specification Section 15883	Air Filters (HVAC)
Specification Section 16150	Motors - Induction
Specification Section 16610	Electrical Requirements for Packaged Equipment
Specification Section 17864	Instruments Furnished with Mechanical Equipment Canister Storage Building

1.4 **DEFINITIONS**

(Not Used)

1.5 **SYSTEM DESCRIPTION**

(Not Used)

1.6 **SUBMITTALS**

Submit the following in accordance with the Vendor Drawing and Data Requirements section of the Order/Subcontract.

1.6.1 Literature - Provide descriptive literature and catalog sheets for each piece of equipment and/or component with manufacturer's name, model number(s), shipping weight and operating weight.

1.6.2 Dimensional Outline Drawings - The drawings shall include:

A. Plan views and assembly drawings.

B. Sectional views showing internal arrangement of all components.

C. Overall dimensions and interfacing dimensions.

D. Location of center of gravity.

E. Mounting holes location and sizes.

F. Size and location of removable lifting lugs.

G. Piping, electrical, and instrumentation connection sizes, types, and locations.

1.6.3 Performance Data - Performance data including tables and curves.

1.6.4 Electrical and Controls - Complete control diagrams, wiring diagrams, control panel detail layout, and electrical schematic diagrams showing voltage and amperage ratings and manufacturer's requirements for equipment protection.

1.6.5 Factory Acceptance Test (FAT) - Test report in accordance with Paragraph 2.1.3 of this specification.

1.6.6 Parts List and Spare Parts List - A complete parts list and a list of manufacturer's recommended spare parts. Include sufficient information to permit procurement of parts from the manufacturer or any subsupplier.

1.6.7 Installation, Operating, and Maintenance Instructions - Detailed installation, operating, and maintenance instructions shall be submitted in accordance with Specification Section 01730, Operation and Maintenance Data.

1.6.8 Inspection and Checkout List

The Seller shall prepare a checklist for the inspection and checkout of the air handling units using the format of Attachment B or other form that includes all the information requested in Attachment B. This checklist shall be submitted to the Buyer and shall include the following as a minimum:

A. Check that the entire assembly is complete with all components and accessories as specified.

B. Check that equipment is undamaged, clean and free of foreign materials.

C. Check that electrical wiring and instrument piping connections are tight.

D. Check that control instruments and instrument piping are undamaged.

E. Verify that all the material is of the type specified herein.

F. Check that damper assembly is undamaged and moved freely from full open position to close position.

G. Equipment has been properly labeled.

1.6.9 Construction Acceptance Test (CAT) - Inspection and testing per Paragraph 3.3.1 of this specification.

1.7 **CLASSIFICATION OF SYSTEM AND COMPONENTS**

(Not Used)

1.8 **PROJECT OR SITE ENVIRONMENTAL CONDITIONS**

1.8.1 Climatic and Geographic Site Conditions

A.	Site Elevation	714 feet above sea level
B.	Barometric Pressure	14.3 psia
C.	Outdoor Design Conditions	
1)	Summer Design Temperature	101°F

2) Winter Design Temperature 9°F

3) Wet Bulb Design Temperature 68°F

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 General

The air handling units covered by this specification shall be provided as a single packaged unit, factory assembled and tested. The units capacity and performance are specified on attached data sheets. Each unit shall be fabricated to the dimensions shown on Attachment C. Each unit shall include the accessories and components as shown on Attachment C and as specified herein.

2.1.2 Air Handling Units (AH-05I-112 and 113)

The air handling units shall be horizontal draw through type with structural housing and base, and shall include fan section, evaporative cooler section, plenum section, mixing box section, and air filters as shown on Attachment C. Unit shall conform to the requirements of ARI 430, AMCA 261 and NFPA 90A.

2.1.2.1 Unit Structural Base

A. Each unit base shall be constructed on a structural base with main beams and secondary cross members of proper size and type as required to support the unit internal components.

B. The base shall be equipped with anchoring lugs and removable lifting lugs.

C. Provisions shall be made for anchoring each unit structural base to the concrete floor with a minimum of 10, equally spaced, 1/2 inch diameter bolts. Bolt holes shall be 11/16 inch diameter.

2.1.2.2 Unit Housing

A. All exterior panels of the housing shall be fabricated from zinc-grip (paint-grip) galvanized steel sheets with a minimum thickness of 16 gauge (0.0635 inch) and a minimum zinc coating of 0.90 ounces per square foot. All sheet metal parts shall be galvanized in accordance with the requirements of ASTM A527-G90. Manufacturer's standard finish shall be provided. The unit interior wetted surfaces shall be provided with 18 gauge, 304 stainless steel liner.

B. The exterior housing panels shall be 24 inches wide and shall be removable. All housing panels shall be of bolted construction using cadmium plated bolts, ASTM A307 and nuts, ASTM A563 at 3 inch intervals installed with cadmium plated washers and neoprene gaskets.

C. Provide housing with one (1) inch thick, three (3) pound density mat-faced fiberglass insulation. Insulation and insulation adhesives shall comply with UL 723.

2.1.2.3 Access Doors

A. Air handling units shall be provided with hinged access doors for access to components. Locations and sizes shall be as indicated on Attachment C.

B. Access doors shall be compatible with the housing construction and shall be designed to swing outward as shown on Attachment C.

C. Access doors shall be of double wall construction with insulation in-between. Minimum overall door thickness shall be one inch. Doors shall be equipped with a continuous stainless steel piano hinge or a minimum of three (3) 3 inch x 2 inch butt hinges per door. An omega type neoprene door gasket set within a grooved extrusion in the door frame shall be used to insure tight closure.

D. Doors shall be equipped with a minimum of three (3) latches. Latches shall be constructed such that doors can be opened from either the outside or the inside of the plenum. Latches shall be Type SP-20 as manufactured by Duro Dyne Corporation, or equal.

E. Bolted access panels to match the unit housing for evap-cooler section removal shall be provided.

2.1.2.4 Fans

A. Supply fans shall be centrifugal double width, double inlet type with a single wheel and shall be of Class I (unless noted on the data sheet) construction in accordance with AMCA Standard 99. The fans shall be rated in accordance with AMCA Standard 210 and ratings corrected for the effect of housing enclosure. Fans shall be electric motor driven through a V-belt system. Both fans and motors shall be mounted on a steel vibration isolator base inside the housing as described in Paragraph 2.1.2.9 of this specification. Certified fan ratings shall be submitted to the Buyer for review and approval.

B. The fan housing and scroll shall be steel fabricated construction, welded, stiffened and braced as necessary to prevent flow-induced flutter, and vibration. Fan discharge shall be provided with internally mounted flexible connection and thrust restraint springs. The discharge opening shall be rectangular and shall have a flanged connection.

C. The fan wheels shall be all welded construction and shall have backwardly inclined airfoil blades. Blades shall be continuously welded to the spun rim and to the hub plate. Hubs shall be close grained cast iron riveted to the hub plate and keyed to the shaft and secured with a minimum of two set screws. Fan wheels shall be designed for continuous operation at the maximum rated fan speed and motor horsepower. Fan wheel assembly shall be statically and dynamically balanced and shall not exceed the vibration level as specified under Paragraph 2.1.3 of this specification.

D. Fan shafts shall be constructed of ASTM A29 Grade 1040 or 1045 hot-rolled steel accurately turned, ground and polished. Shafts shall be of solid construction. The fan shaft/wheel assembly shall be designed such that the first critical speed shall be at least 25 percent greater than the fan design speed. Ends shall be centered for RPM counters.

E. Bearings shall be grease lubricated, self-aligning, antifriction pillow block type ball bearings designed for a L-10 life of 120,000 hours at maximum operating conditions in accordance with ANSI/AFBMA 9. Fan bearings shall have grease leads extended to an accessible point outside of unit housing for central lubrication through a grease fittings. Lubrication instructions shall be provided near the grease fitting by means of a stamped metal plate. Bearings shall be as manufactured by SKF, or equal.

F. The drive transmission shall be of the multiple V-belt type. V-belt drives shall be sized for at least 150 percent of the drive motor nameplate horsepower. Motor drives shall be fixed (nonadjustable) drives. V-belts shall be provided in matched sets. One extra set of V-belts shall be shipped to the Buyer with each unit.

G. Fans shall have a nonoverloading performance characteristic.

2.1.2.5 Motors

A. Fan driver motor shall be provided in accordance with Specification Section 16150, and as indicated herein.

B. Motor shall be provided with an adjustable base and shall be mounted on the fan vibration isolation base. Adjustment shall be adequate to provide for replacement of belts, proper alignment, and belt tension adjustment.

C. Motor grease fittings shall be accessible outside the plenum. Where required, extended grease lines with grease fittings shall be provided.

D. Fan motor name plate shall be a minimum of 20 percent greater than the maximum fan brake horsepower at the rated speed.

2.1.2.6 Evaporative Cooler Section

A. Casings shall be minimum 16 GA 304 stainless steel fastened to structural steel by 1/4 inch cadmium plated bolts, ASTM A307. Inlet and outlet flanges shall be 1-1/2 inch with 1/2 inch bolt holes 6 inches on centers. An access door shall be provided for servicing.

B. The water basin shall be minimum 10 GA thick, 12 inch deep all-welded construction with 304 stainless steel material. Makeup connection shall be 1-1/2 inch Female Pipe Thread (FPT) with float valve and float. Unit shall have removable copper mesh suction screen, properly sized drain, overflow, and quickfill connections.

C. Media shall be noncorrosive and impervious to fungus growth. Media shall be fiberglass with UL 900 Class II fire rating.

D. Unit shall be complete with water distribution piping. Provide an internal bleed-off line. Piping shall be Sch. 40, stainless steel conforming to ASTM A312.

E. A circulating pump shall be provided with the evaporative cooler integral with the unit. Spray pump shall be centrifugal, closed-coupled with horizontal shaft. Pump shall be provided with stainless steel sleeve. Pump unit shall conform to UL 778, and shall be rated at 125 psig. Pump capacity shall be as indicated on the attached data sheet DS-1.

F. Associated valves and factory prewired controls shall be provided.

2.1.2.7 Air Filter Section

Air handling units shall be provided with air filters of the type, efficiency and arrangement as shown on Attachment C and as indicated on the attached data sheets. Air filter section shall

allow for convenient replacement and inspection. Air filters shall be "Type I" and "Type IIA" as provided in accordance with Specification Section 15883. Filters shall comply with ARI-850. Filter gages shall be provided in accordance with Specification Section 17864. One extra set of air filters shall be shipped to the Buyer with each unit.

2.1.2.8 Mixing Box

Provide mixing box with flanged connections to match the basic unit. Air intake openings shall be sized to individually handle the unit full air flow capacity. Arrange openings as indicated on Attachment C. Provide openings with dampers of opposed blade type. Connect damper shafts together with one continuous linkage bar. Arrange dampers for automatic operation so that when one starts to close from its open position, the other starts to open from its closed position. Dampers shall be "Automatic Dampers - Type I", with pneumatic actuators as provided in accordance with Specification Section 15861. Damper actuators shall be externally mounted.

2.1.2.9 Vibration Isolators

The fan and motor shall be mounted on a common vibration isolation base inside the air handling unit housing. The base shall be manufactured of minimum 4 inch structural main members. Secondary cross members shall be of the size and type required to support the fan and motor. The vibration isolator shall be "Spring Type" as provided in accordance with Specification Section 15200.

2.1.2.10 Controls and Instrumentation

Unit associated controls and instrumentation, and the instrument racks shall be furnished and supplied with the air handling units. The instrument racks, controls and instrumentation shall be provided in accordance with Specification Section 17864.

2.1.2.11 Electrical Requirements

The air handling units electrical requirements shall be in accordance with Specification Section 16610.

2.1.3 Factory Acceptance Test

2.1.3.1 Each air handling unit shall be inspected and factory tested for vibration prior to shipment from the factory.

2.1.3.2 The vibration tests shall be performed on each fan with each motor to assure that the amplitude of vibration (displacement in mils), at operating speed and measured at each unit fan bearing and motor

bearing shall not exceed the value interpolated from the following table:

Fan or Motor RPM	500	800	1100	1400	1700	2100	
mils (peak to peak)	4.2	3.0	2.3	1.9	1.6	1.3	(in each plane)

2.1.3.3 Inspection and vibration test procedures, and test results shall be documented, and shall be included in the submittal requirements of this specification. Test procedures shall be submitted to Buyer for review and approval prior to start of test.

2.1.3.4 Test records shall contain the following information as a minimum:

A. Unit tested.
B. Date of test.
C. Equipment, instrumentation and data recorder used.
D. Type of observation.
E. Results and acceptability.
F. Action taken in connection with any deviations noted, if any.
G. Name(s) and title of person(s) evaluating test results.

2.1.3.5 Test results shall be evaluated by a responsible authority (Seller) to assure that test requirements are satisfied. Test results shall be submitted to the Buyer for review and approval.

2.2 FABRICATION AND MANUFACTURE

(Not Used)

2.3 LABELING

In addition to the manufacturer's identification nameplate, each unit shall be supplied with a corrosion-resistant metal tag identification in accordance with Specification Section 15196, Paragraph 2.2.2.9.

2.4 PACKAGING

Preparation for shipment and packing shall conform to the manufacturer's standards and shall provide protection against corrosion and damage from normal handling. Preparation shall include the following:

2.4.1 Machined surfaces and threads shall be protected during shipment by application of grease or other suitable rust inhibiting compound.

2.4.2 Piping openings to equipment shall be suitably protected to prevent damage during shipment and storage and the openings shall be plugged or capped to prevent contamination.

2.4.3 Temporary bracing, supports, and rigging connections shall be provided as necessary to prevent damage during shipment, lifting, and unloading.

2.4.4 Separate or loose parts shall be completely boxed and attached to the main equipment and shipped as a unit. All shipping boxes shall be identified with the equipment number(s), Seller's purchase order number, description of the equipment, manufacturer's name, Seller's name, project identification, and destination with ink, paint, or other indelible material. A copy of the packing list shall be securely affixed to the outside of each package or crate.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Before installation, Seller shall review all pertinent documentation and verify the following:

3.1.1.1 All documentation (data and drawings) required by Paragraph 1.6 of this specification has been submitted to the Buyer.

3.1.1.2 The Seller has received from the Buyer approved specifications and Contract Drawings covering all equipment and piping to be installed.

3.1.1.3 Inspect each unit to make sure that it is complete with all accessories as specified.

3.1.1.4 Inspect the foundation or pad on which the units will be installed to make sure it is of the size required.

3.1.1.5 Verify that the components carry the required certifications in accordance with Paragraph 2.1 of this specification.

3.2 INSTALLATION, APPLICATION AND ERECTION

3.2.1 Install air handling units and instrument racks in accordance with the manufacturer's instructions, this specification and the Contract Drawings.

3.2.2 Provide touch-up to match factory applied finish if coatings have been scratched or disturbed.

3.2.3 Provide and install condensate drain trap and drain lines as indicated on the Contract Drawings.

3.3 **FIELD QUALITY CONTROL**

3.3.1 Inspection and testing shall be performed as required by field inspection and checkout checklist (Attachment B).

3.4 **ADJUSTMENTS**

(Not Used)

3.5 **CLEANING**

(Not Used)

3.6 **PROTECTION**

(Not Used)

3.7 **DEMONSTRATION**

(Not Used)

3.8 **SCHEDULES**

(Not Used)

END OF SECTION

ATTACHMENT A
DATA SHEET E350-DS-1
AIR HANDLING UNITS (EVAPORATIVE COOLER TYPE)

PROJ/BLDG : HWVP / CANISTER STORAGE BLDG.
SPEC. NO. : B-595-C-E350-15782
PREPARED BY : B. ENTEZAM B.E.
CHECKED BY : R. FLYE RF

EQUIPMENT NAME: OPERATING AREA / EQUIP. ROOM AHU
EQUIPMENT NO.: AH-05I-112 & AH-05I-113

SELECTION:		EVAPORATIVE COOLER: (EC-05I-112 & 113)		
MANUFACTURER	*	VELOCITY ACROSS MEDIA, FPM	450	
MODEL NO.	*	MEDIA DEPTH, IN.	*	
QUANTITY REQUIRED	2	PUMP GPM	12	
HORIZONTAL OR VERTICAL	HORIZONTAL	PUMP MOTOR, HP (max.)	1/3	
LOW, MEDIUM OR HIGH PRESSURE	MEDIUM	VOLTS, PHASE, HZ	120/1/60	
SYSTEM TYPE	EVAP. COOLER	EFFICIENCY, (min.)	90%	
FAN: (BL-05I-112 & 113)		FILTERS:		
AIRFLOW, SCFM	12000	ARRANGEMENT	FLAT	FLAT
TOTAL S.P., IN. W.G.	4.5	MEDIA VELOCITY, FPM (max.)	500	500
BRAKE HP	*	NBS EFFICIENCY RATING	30%	95%
RPM	*	CLEAN PRESSURE DROP, IN. W.G.	0.3	0.65
OUTLET VELOCITY, FPM	*	MAX. PRESSURE DROP, IN. W.G.	1.0	1.2
DISCHARGE POSITION	UP BLAST (REAR)	TYPE	I	IIA
WHEEL TYPE / CLASS	CENTRIFUGAL / II	ACCESSORIES:		
NOMINAL WHEEL DIA. IN.	*	ADJUSTABLE MOUNTING BASE	YES	
BAROMETRIC PRESSURE, IN. HG.	29.16	VIBRATION ISOLATION TYPE	YES	
		CONTROLS	SEE SPEC.	
MOTOR: (MT-05I-112A & 113A)				
H.P. (max.)	15	TOTAL WEIGHT, LBS	*	
VOLTS, PHASE, HZ	460/3/60			
ENCLOSURE	T.E.F.C.			
DRIVE TYPE	V BELT	MAXIMUM EQUIPMENT ENVELOPE	SEE ATTACHMENT C	
SERVICE FACTOR	1.15			
MOTOR SHEAVE	FIXED			

REMARKS:

*FURNISHED BY EQUIPMENT VENDOR

ATTACHMENT B
FIELD INSPECTION AND CHECKOUT CHECKLIST
AIR HANDLING UNITS
(EVAPORATIVE COOLER TYPE)

Equipment Number _____ Purchase Order No. _____

Location _____

Installed By _____ Mfr. _____

Specification No. _____ Rev. _____ Dwg. No. _____ Rev. _____

NOTES: 1) This checklist covers the general requirements for the inspection and testing of equipment for start-up. It should be used in conjunction with the manufacturer's installation, testing and operating instructions.
2) All test equipment and instrumentation shall be properly calibrated per manufacturer's instructions. Items out of calibration or damaged shall not be used for testing.
3) Record all defects, missing parts, etc., and action taken to correct.

Items to Inspect/Check/Test	Installation Meets Requirements Signature	Recorded Data Remarks
(Inspection/check/test procedures to be detailed in this section. Items should be listed in the order to be accomplished.)		

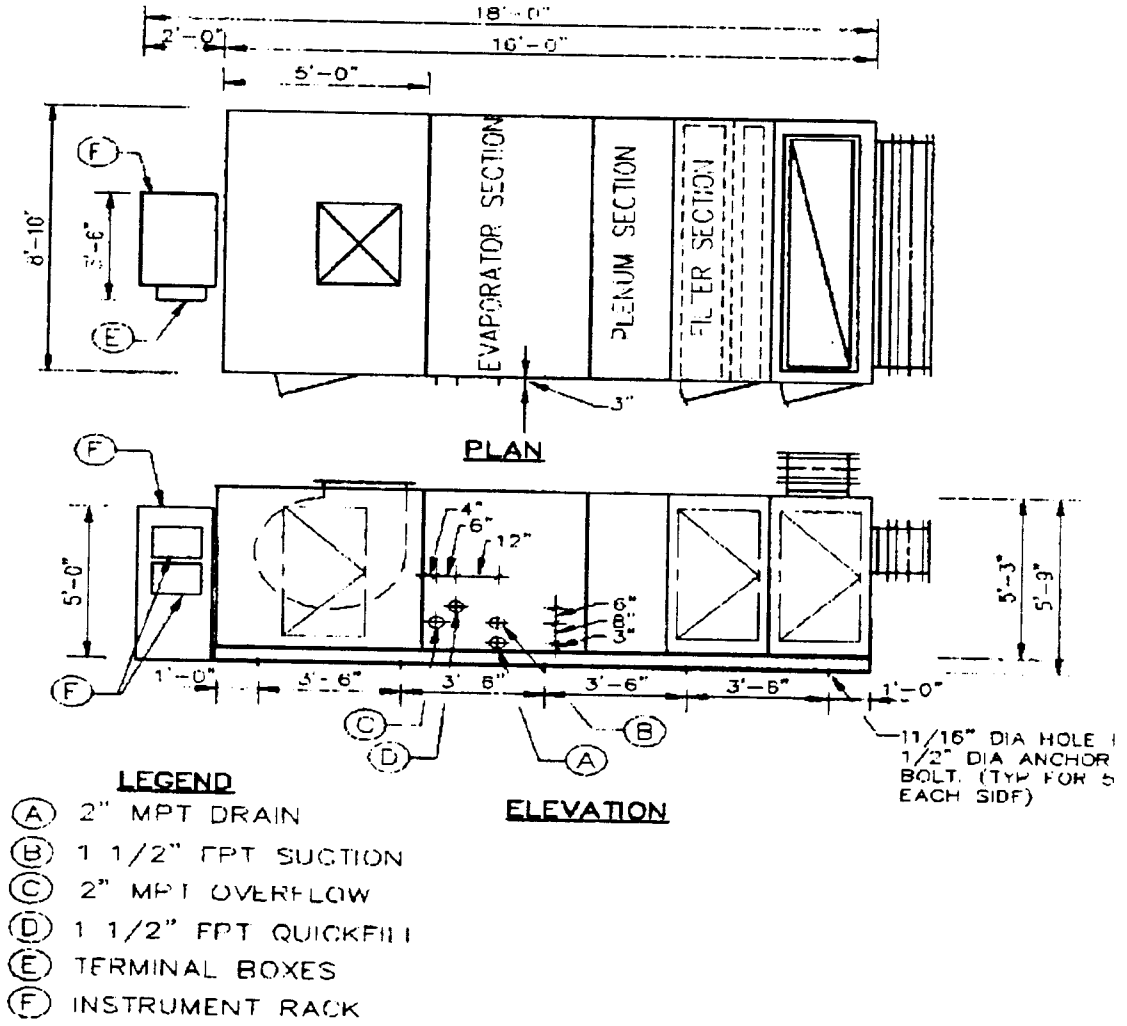
PROCEDURE APPROVAL SELLER REPRESENTATIVE _____ DATE _____

BUYER'S REPRESENTATIVE _____ DATE _____

TEST COMPLETION ACKNOWLEDGEMENT SELLER REPRESENTATIVE _____ DATE _____

BUYER'S REPRESENTATIVE _____ DATE _____

ATTACHMENT C
UNIT CONFIGURATION LAYOUT
AIR HANDLING UNITS (EVAPORATIVE COOLER TYPE)



LEGEND

- (A) 2" MPT DRAIN
- (B) 1 1/2" FPT SUCTION
- (C) 2" MPT OVERFLOW
- (D) 1 1/2" FPT QUICKFILL
- (E) TERMINAL BOXES
- (F) INSTRUMENT RACK

NOTE: MAXIMUM EQUIPMENT ENVELOPE = 18'-0" L x 9'-0" W x 6'-0" H
AH-05I-112, 113

U.S. DEPARTMENT OF ENERGY
Hanford Waste Vitrification Plant
Richland, Washington
DOE Contract DE-AC06-86RL10838

FLUOR DANIEL, INC.
Advanced Technology Division
Fluor Contract 8457

SECTION 15832
MISCELLANEOUS FANS (HVAC)
B-595-C-E350-15832

APPROVED FOR CONSTRUCTION

REVISION 1 PER CR-0859
ISSUE DATE 7/14/93

WAPA YES ___ NO X
QUALITY LEVEL I ___ II X
SAFETY CLASS 1__ 2__ 3 X 4__

ORIGINATOR:

B. Entezam 7,8,93
B. Entezam, HVAC Engineer Date

CHECKER:

R. E. Flye 7.8.93
R. E. Flye, HVAC Engineer Date

APPROVED BY:

M. G. Mercado 7/14/93
M. G. Mercado Lead Discipline Engineer Date

SECTION 15832
MISCELLANEOUS FANS (HVAC)
B-595-C-E350-15832

TABLE OF CONTENTS

ATTACHMENTS

SECTION 15832
MISCELLANEOUS FANS (HVAC)

PART 1 GENERAL

1.1 SUMMARY

This section defines the minimum technical requirements for furnishing, installing and checking out a ceiling exhaust fan.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AIR MOVING AND CONDITIONING ASSOCIATION (AMCA)

AMCA Standard 210	1974 Laboratory Methods of Testing Fans for Rating Purposes
AMCA Standard 300	1985 (Rev 1987) Reverberant Room Method for Sound Testing of Fans

1.3 RELATED REQUIREMENTS

Specification Section 01730	Operation and Maintenance Data
Specification Section 15196	Identification and Tagging Method for Mechanical Equipment
Specification Section 16110	Electrical Materials and Devices
Specification Section 16610	Electrical Requirements for Packaged Equipment

1.4 DEFINITIONS

(Not Used)

1.5 SYSTEM DESCRIPTION

(Not Used)

1.6 SUBMITTALS

Submit the following in accordance with the Vendor Drawing and Data Requirements section of the Order/Subcontract.

1.6.1 Literature - Descriptive literature and catalog sheets for each fan with manufacturer's name, model number(s), shipping weight and operating weight.

1.6.2 Dimensional Outline Drawings - The drawings shall include:

A. Plan views and assembly drawings.

B. Sectional views showing internal arrangement of components and showing method of removal of fan and motor.

C. Overall dimensions and interfacing dimensions.

D. Mounting holes location and sizes.

E. Electrical connection size and locations.

1.6.3 Performance Data - Performance data including tables and curves.

1.6.4 Factory Acceptance Test (FAT) - Certification of performance rating in accordance with Paragraph 2.1.1.1 of this specification.

1.6.5 Control Diagrams - Complete control diagrams, wiring diagrams and electrical schematic diagrams with power voltage and amperage ratings and manufacturer's requirements for equipment protection.

1.6.6 Parts List and Spare Parts List - A complete parts list and a list of manufacturer's recommended spare parts. Include sufficient information to permit procurement of parts from the manufacturer or any subsupplier.

1.6.7 Installation, Operating, and Maintenance Instructions - Detailed installation, operating, and maintenance instructions shall be submitted in accordance with Specification Section 01730, Operation and Maintenance Data.

1.6.8 Inspection and Checkout List

The Seller shall prepare a checklist for the inspection and checkout of the miscellaneous fans using the format of Attachment B or other form that includes all the information requested in Attachment B. This checklist shall be submitted to the Buyer and shall include the following as a minimum:

A. Fan is installed in accordance with the manufacturer's recommendations, the Contract Drawings, and this specification.

B. Fan has been leveled, aligned and securely fastened with bolts to supporting structure.

C. Check that fan assembly is undamaged, clean and free of foreign materials.

D. Check that fan-motor bearings are lubricated in accordance with manufacturer's recommendations.

E. Check that fan is in alignment and rotates freely.

F. Verify impeller rotation (direction and interference).

G. Verify motor current full load amperes (FLA's) is within nameplate rating.

H. Verify motor voltage is within nameplate rating.

I. Fan unit(s) has been properly labeled.

J. Fans and motors have been checked for vibration and noise, and in conformance with the manufacturer's published performance data.

1.6.9 Construction Acceptance Test (CAT) - Inspection and testing per Paragraph 3.3.1 of this specification.

1.7 **CLASSIFICATION OF SYSTEM AND COMPONENTS**

(Not Used)

1.8 **PROJECT OR SITE ENVIRONMENTAL CONDITIONS**

1.8.1 Climatic and Geographic Site Conditions

A. Site Elevation 714 feet above sea level

B. Barometric Pressure 14.3 psia

C. Outside Design Temperature

1) Summer Design Temperature 101°F

2) Winter Design Temperature 9°F

3) Wet Bulb Design Temperature 68°F

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 General

2.1.1.1 The fan shall be tested and rated in accordance with AMCA Standards 210 and comply with the requirements of the AMCA certified rating program. AMCA rated for sound when tested to AMCA 300.

2.1.1.2 Provide fan unit with direct drive motor.

2.1.1.3 Capacity and performance of the fan unit shall be as specified on the data sheet attachment.

2.1.2 Ceiling Exhaust Fan

2.1.2.1 Provide ceiling exhaust fan, complete with housing, hanging brackets, fan, motor grille and integral backdraft damper. Fan shall bear the AMCA Certified Rating Seal for both air and sound.

2.1.2.2 Fan housing shall be of galvanized steel construction with acoustical insulation and have maximum sound level ratings noted on manufacturer's performance data. Face grille shall be of aerodynamic design with 85 percent free open area. Grille shall comply with OSHA requirements. Grille shall have a white baked enamel finish. Fan unit housing shall be provided with manufacturer's standard finish.

2.1.2.3 Fan wheel shall be centrifugal type forward-curve constructed of galvanized steel, and shall be statically and dynamically balanced. Fan motor shall be suitably grounded and mounted on vibration isolators. Motor shall have permanently lubricated ball bearings, continuous duty, and shall be thermally protected. The entire fan, motor and wheel assembly shall be removable without disturbing the housing.

2.1.2.4 Fan shall be completely prewired with an accessible terminal box for electrical connection in accordance with Specification Section 16610 - Electrical Requirements for Packaged Equipment.

2.1.2.5 Fan unit accessories shall be provided as follows:

A. Hooded Wall Cap: For outside wall application with bird-screen.

B. Hanging Rods Kit: Kit shall include nuts, gaskets and lock washers.

2.1.2.6 Wall mounted switch, HS (not furnished with the fan) shall be provided in accordance with Specification Section 16110, and as shown on electrical Contract Drawings.

2.2 **FABRICATION AND MANUFACTURER**

(Not Used)

2.3 **LABELING**

In addition to the manufacturer's identification nameplate, each fan unit shall be supplied with a corrosion-resistant metal tag identification in accordance with Specification Section 15196, Paragraph 2.2.2.9.

2.4 **PACKAGING**

Preparation for shipment and packing shall conform to the manufacturer's standards and shall provide protection against corrosion and damage from normal handling. Preparation shall include the following:

2.4.1 Machined surfaces and threads shall be protected during shipment by application of grease or other suitable rust inhibiting compound.

2.4.2 Electrical conduit opening to equipment shall be suitably protected to prevent damage to threads during shipment and storage and shall be plugged or capped.

2.4.3 Temporary bracing, supports, and rigging connections shall be provided as necessary to prevent damage during shipment, lifting, and unloading.

2.4.4 Separate or loose parts shall be completely boxed and attached to the main equipment and shipped as a unit. All shipping boxes shall be identified with the equipment number(s), Seller's purchase order number, description of the equipment, manufacturer's name, Seller's name, project identification, and destination with ink, paint, or other indelible material. A copy of the packing list shall be securely affixed to the outside of each package or crate.

PART 3 EXECUTION

3.1 **PREPARATION**

Before installation, Seller shall review all pertinent documentation and verify the following:

3.1.1 All documentation (data and drawings) required by Paragraph 1.6 of this specification has been submitted to the Buyer.

3.1.2 The Seller has received from the Buyer approved specifications data and Contract Drawings covering the fan unit to be installed.

3.1.3 Inspect fan unit to make sure that it is complete with all accessories.

3.1.4 Inspect the structure by which the fan unit will be supported to make sure it is of the size and location required, and that mounting holes are located to match the position of the fan unit mounting base holes location.

3.1.5 Fan unit is properly labeled.

3.2 **INSTALLATION, APPLICATION AND ERECTION**

3.2.1 Install ceiling exhaust fan unit in accordance with the manufacturer's instructions, the Contract Drawings and the requirements of this specification.

3.2.2 Provide four (4) 3/8 inch diameter hanging threaded rods, supported from roof structural steel.

3.2.3 To ensure protection from the environment, the Seller shall paint or coat fan unit casing and accessories with paint to match manufacturer's prime and finish paint where coating has been disturbed.

3.3 **FIELD QUALITY CONTROL**

3.3.1 Inspection and testing shall be performed as required by field inspection and checkout checklist (Attachment B).

3.4 **ADJUSTMENTS**

(Not Used)

3.5 **CLEANING**

(Not Used)

3.6 **PROTECTION**

(Not Used)

3.7 **DEMONSTRATION**

(Not Used)

3.8 SCHEDULES

(Not Used)

END OF SECTION

ATTACHMENT A
DATA SHEET E350-DS-1
MISCELLANEOUS FANS

PROJ/BLDG : HWVP / CANISTER STORAGE BLDG.
SPEC. NO. : B-595-C-E350-15832
PREPARED BY : B. ENTEZAM B.E.
CHECKED BY : R. FLYE RCF

EQUIPMENT NAME: TOILET EXHAUST FAN
EQUIPMENT NO.: BL-05J-114

SELECTION:		MOTOR :	
MANUFACTURER	*	EQUIPMENT NO.	MT-05J-114
MODEL NO.	*	VOLTS, PHASE, HERTZ	120/1/60
SIZE	*	HORSEPOWER	*
QUANTITY REQUIRED	1	SERVICE FACTOR	1.15
		ACCESSORIES:	
PERFORMANCE:		HOODED WALL CAP	YES
AIRFLOW, SCFM	200	HANGING RODS KIT	YES
POWER REQUIRED, WATTS (max.)	105		
STATIC PRESSURE, IN W.G.	0.125		
FAN SPEED, RPM	1030		
TEMPERATURE AT INLET, DEG F	70		
BAROMETRIC PRESS. AT INLET, " Hg	29.16		

REMARKS:

*FURNISHED BY EQUIPMENT VENDOR

ATTACHMENT B
FIELD INSPECTION AND CHECKOUT CHECKLIST

MISCELLANEOUS FANS

Equipment Number _____ Purchase Order No. _____

Location _____

Installed By _____ Mfr. _____

Specification No. _____ Rev. _____ Dwg. No. _____ Rev. _____

NOTES: 1) This checklist covers the general requirements for the inspection and testing of equipment for start-up. It should be used in conjunction with the manufacturer's installation, testing and operating instructions.
2) All test equipment and instrumentation shall be properly calibrated per manufacturer's instructions. Items out of calibration or damaged shall not be used for testing.
3) Record all defects, missing parts, etc., and action taken to correct.

Items to Inspect/Check/Test	Installation Meets Requirements Signature	Recorded Data Remarks
(Inspection/check/test procedures to be detailed in this section. Items should be listed in the order to be accomplished.)		

PROCEDURE APPROVAL — SELLER REPRESENTATIVE _____ DATE _____

PROCEDURE APPROVAL — BUYER'S REPRESENTATIVE _____ DATE _____

TEST COMPLETION ACKNOWLEDGEMENT — SELLER REPRESENTATIVE _____ DATE _____

TEST COMPLETION ACKNOWLEDGEMENT — BUYER'S REPRESENTATIVE _____ DATE _____

U.S. DEPARTMENT OF ENERGY
Hanford Waste Vitrification Plant
Richland, Washington
DOE Contract DE-AC06-86RL10838

FLUOR DANIEL, INC.
Advanced Technology Division
Fluor Contract 8457

SECTION 15836
ELECTRIC DUCT HEATERS
B-595-C-E350-15836

APPROVED FOR CONSTRUCTION

REVISION 1 PER CR-0859
ISSUE DATE 8/4/93

WAPA YES ___ NO X
QUALITY LEVEL I ___ II X
SAFETY CLASS 1__ 2__ 3 X 4__

ORIGINATOR:

Behzad Entezam 7,8,93
B. Entezam, HVAC Engineer Date

CHECKER:

R. E. Flye 7.8.93
R. E. Flye, HVAC Engineer Date

APPROVED BY:

Manuel G. Mercado 7/14/93
M. G. Mercado Lead Discipline Engineer Date

SECTION 15836
ELECTRIC DUCT HEATERS
B-595-C-E350-15836

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ATTACHMENTS

SECTION 15836
ELECTRIC DUCT HEATERS

PART 1 GENERAL

1.1 SUMMARY

This section defines the minimum technical requirements for furnishing, installing, testing and checking out electric duct heaters.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	1985 Enclosures for Electrical Equipment (1000 Volts Maximum) - (Revision 1 - May 1986, Revision 2 - May 1988)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	1990 National Electrical Code

UNDERWRITERS LABORATORIES, INC. (UL)

UL 1096	1986 (R 1988) Electric Central Air Heating Equipment, Fourth Edition

1.3 RELATED REQUIREMENTS

Specification Section 01730	Operation and Maintenance Data
Specification Section 15196	Identification and Tagging Method for Mechanical Equipment
Specification Section 16610	Electrical Requirements for Packaged Equipment
Specification Section 17605	Room Thermostats-Electronic
Specification Section 17864	Instruments Furnished with Mechanical Equipment Canister Storage Building

1.4 **DEFINITIONS**

(Not Used)

1.5 **SYSTEM DESCRIPTION**

(Not Used)

1.6 **SUBMITTALS**

Submit the following in accordance with the Vendor Drawing and Data Requirements section of the Order/Subcontract.

1.6.1 Literature - Provide descriptive literature and catalog sheets for each piece of equipment and/or component with manufacturer's name, model number(s), shipping weight and operating weight.

1.6.2 Dimensional Outline Drawings - The drawings shall include:

A. Plan views and assembly drawings.

B. Sectional views showing internal arrangement of components.

C. Overall dimensions and interfacing dimensions.

D. Mounting hole locations and sizes.

E. Electrical, control and instruments connection sizes and locations (including required field interface connections).

1.6.3 Performance Data - Performance data including tables and curves.

1.6.4 Factory Acceptance Test (FAT) - Test report in accordance with Paragraph 2.1.3 of this specification.

1.6.5 Control Diagrams - Complete control diagrams, wiring diagrams and electrical schematic diagrams with power voltage and amperage ratings and manufacturer's requirements for equipment protection.

1.6.6 Parts List and Spare Parts List - A complete parts list and a list of manufacturer's recommended spare parts. Include sufficient information to permit procurement of parts from the manufacturer or any subsupplier.

1.6.7 Installation, Operating, and Maintenance Instructions - Detailed installation, operating, and maintenance instructions shall be submitted in accordance with Specification Section 01730, Operation and Maintenance Data.

1.6.8 Inspection and Checkout List

The Seller shall prepare a checklist for the inspection and checkout of the electric duct heaters using the format of Attachment B or other form that includes all the information requested in Attachment B. This checklist shall be submitted to the Buyer and shall include the following as a minimum:

A. Duct heater is clean and undamaged.

B. Duct heater is installed in accordance with the manufacturer's recommendations, this specification and drawings.

C. All safety and operating controls have been cycled and are fully functional.

D. Check that duct and heater flanged connections are securely fastened with bolts.

E. Check that duct heater internal electrical wiring and controls are undamaged and connections are tight. Check that fuses are installed.

F. Heater current (within nameplate rating).

G. Check that each duct heater has been properly labeled.

1.6.9 Construction Acceptance Test (CAT) - Inspection and testing per Paragraph 3.3.1 of this specification.

1.7 **CLASSIFICATION OF SYSTEMS AND COMPONENTS**

(Not Used)

1.8 **PROJECT OR SITE ENVIRONMENTAL CONDITIONS**

(Not Used)

PART 2 PRODUCTS

2.1 **MATERIALS AND EQUIPMENT**

2.1.1 General

2.1.1.1 Electric duct heaters shall be the flanged type suitable for duct mounting.

2.1.1.2 Electric duct heaters shall be suitable for zero clearance mounting in accordance with UL 1096 and shall meet all NEC (NFPA 70) requirements.

2.1.1.3 Capacity, ratings and installation shall be as indicated in this specification and on the data sheet Attachment A. Three-phase heaters shall have balanced phases.

2.1.2 Construction

2.1.2.1 Element

The electric heating element shall be of the open type, constructed from iron free 80 percent nickel, 20 percent chromium resistance wire. The electric heating element shall be uniformly spaced across the face of the heating coil to avoid stratification. The watt density of heating element shall not exceed 25 watts per square inch of heater element. Heating elements shall be terminated within terminal box via ceramic insulators and stainless steel terminal screws with stainless steel hexagonal nuts.

2.1.2.2 Frame

A. The heater frame shall be galvanized steel construction, reinforced as required to provide rigidity. Brackets shall be provided at not to exceed 4 inch spacing within the heater frame for the support of the heating elements. Ceramic standoff bushings shall be provided to insulate the heating element from the frame and support brackets.

B. The duct heater frame shall have 2 inch minimum flanges turned to the outside for connection to ductwork. The flanges shall be reinforced with flat stock of the same type of material as the heater frame so that the heater frame and reinforcement have a combined minimum thickness of 1/4 inch. Drill 7/16 inch diameter bolt holes in the flanges to match the connections ductwork. Bolt holes shall be maximum four (4) inches center-to-center.

2.1.2.3 Terminal Box

Provide a hinged front galvanized steel terminal box NEMA 12 in accordance with NEMA 250 and integral with the duct heater. The terminal box shall be factory assembled and factory wired with necessary components as herein specified and as required to provide a complete and operating unit. The terminal box shall be constructed of 12 gauge minimum thickness galvanized steel. Sufficient clearance of terminal box contents from the box top, bottom and sides shall be provided to allow fastening of terminal box to external support steel with metal fasteners.

2.1.2.4 Disconnect Switch

Provide a locking type, fused, main electrical disconnect switch which prevents the door of the terminal box from being opened unless the switch is first turned to the off position in accordance with NFPA 70.

2.1.2.5 Control Transformer

Provide a factory mounted and factory wired 480/24 volt control transformer to provide power to the control circuit.

2.1.2.6 Safety Contactor

Provide a disconnecting break magnetic contactor which shall interrupt all ungrounded conductors to the heater when contactor is deenergized.

2.1.2.7 Electrical

Electric duct heaters electrical requirements shall be in accordance with Specification Section 16610, and as indicated herein.

2.1.2.8 Protection Screen

Provide a 1/2 inch by 1/2 inch galvanized steel hardware cloth on both the inlet side and outlet side of the duct heater.

2.1.2.9 Controls

2.1.2.9.1 Provide a complete system of safety and operating controls as specified herein and in accordance with UL 1096 and NFPA 70. All safety and operating controls shall be serviceable without removing the duct heater assembly from the ductwork.

2.1.2.9.2 A multi-step controller (JC) shall be furnished with the unit and shall be provided in accordance with Specification Section 17864. Room thermostat (not furnished with the duct heater unit) shall be provided in accordance with Specification Section 17605.

2.1.2.9.3 Provide a thermally operated automatic reset safety switch to interrupt the control voltage to the safety contactor in the event of overheating. The primary safety switch shall be of the bimetal type and shall be rated for 100,000 cycles per UL 1096. Provide load break type manual reset secondary thermal cutout switch to deenergize the heater in the event of overheating and a failure of the primary thermal cutout.

2.1.2.9.4 Provide a pressure type airflow switch factory wired in series with the automatic reset cutout to guard against airflow failure.

The switch shall be of the differential pressure diaphragm-operated type and shall require a minimum operating total pressure differential of 0.07" W.C. The sampling probe shall be suitable for left- or right-hand airflow installation for field adjustment so the probe faces upstream.

2.1.3 Factory Acceptance Test (FAT)

2.1.3.1 Electric duct heaters shall be dielectrically tested at 2000 volts. The resistance of each heating element must be measured and recorded and must be within 5 percent of rated value. Test procedures shall be documented and shall be included in the submittal requirements of this specification.

2.1.3.2 Test records shall contain the following information as a minimum:

1) Electric duct heater tested
2) Date of test
3) Equipment, instrumentation and data recorder used
4) Type of observation
5) Results and acceptability
6) Action taken in connection with any deviations noted, if any
7) Name(s) and title of person(s) evaluating test results.

2.1.3.3 Test results shall be evaluated by a responsible authority (Seller) to assure that test requirements are satisfied. Test results shall be submitted to the Buyer for review and approval.

2.2 **FABRICATION AND MANUFACTURE**

(Not Used)

2.3 **LABELING**

In addition to the manufacturer's identification nameplate, each unit shall be supplied with a corrosion-resistant metal tag identification in accordance with Specification Section 15196, Paragraph 2.2.2.9.

2.4 **PACKAGING**

Preparation for shipment and packing shall conform to the manufacturer's standards and shall provide protection against corrosion and damage from normal handling. Preparation shall include the following:

2.4.1 Machined surfaces and threads shall be protected during shipment by application of grease or other suitable rust inhibiting compound.

2.4.2 Openings to equipment shall be suitably protected to prevent damage to flanges and threads during shipment and storage and shall be plugged or capped to prevent contamination.

2.4.3 Temporary bracing, supports, and rigging connections shall be provided as necessary to prevent damage during shipment, lifting, and unloading.

2.4.4 Separate or loose parts shall be completely boxed and attached to the main equipment and shipped as a unit. All shipping boxes shall be identified with the equipment number(s), Seller's purchase order number, description of the equipment, manufacturer's name, Seller's name, project identification, and destination with ink, paint, or other indelible material. A copy of the packing list shall be securely affixed to the outside of each package or crate.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Before installation the Seller shall review all pertinent documentation and verify the following:

3.1.1.1 All documentation (data and drawings) required by Paragraph 1.6 of this specification has been submitted to the Buyer.

3.1.1.2 The Seller has received from the Buyer approved specifications and Contract Drawings covering all equipment to be installed.

3.1.1.3 Inspect the ductwork where the duct heater will be installed and verify that the ductwork flanged connection size is compatible with the duct heater. Verify that adequate clearance will exist adjacent to the electric terminal box as required by NFPA 70.

3.1.1.4 Inspect each electric duct heater to make sure that it is complete with all accessories.

3.1.1.5 Electric duct heaters are properly labeled.

3.2 INSTALLATION, APPLICATION AND ERECTION

3.2.1 Install the duct heaters in accordance with the manufacturer's instructions, this specification and the Contract Drawings.

3.2.2 To assure protection from the environment, the seller shall paint or coat unit heater casing with paint to match manufacturer's prime and finish paint where coating has been disturbed.

3.3 **FIELD QUALITY CONTROL**

3.3.1 Inspection and testing shall be performed as required by field inspection and checkout checklist (Attachment B).

3.4 **ADJUSTMENTS**

(Not Used)

3.5 **CLEANING**

(Not Used)

3.6 **PROTECTION**

(Not Used)

3.7 **DEMONSTRATION**

(Not Used)

3.8 **SCHEDULES**

(Not Used)

END OF SECTION

ATTACHMENT A
DATA SHEET E350-DS-1
ELECTRIC DUCT HEATERS

PROJ/BLDG : HWVP / CANISTER STORAGE BLDG.
SPEC. NO. : B-595-C-E350-15836
PREPARED BY : B. ENTEZAM B.E.
CHECKED BY : R. FLYE QA

EQUIPMENT NO.:	EH-05I-115	EH-05I-116	EH-05I-117	
SELECTION:				
MANUFACTURER	*	*	*	
MODEL NO.	*	*	*	
QUANTITY REQUIRED	1	1	1	
PERFORMANCE:				
CFM STANDARD AIR	250	750	900	
NO. OF STEPS	2	2	2	
SENSIBLE HEAT BTU/HR				
DIRECTION OF AIRFLOW	HORIZONTAL	HORIZONTAL	HORIZONTAL	
RESISTANCE, IN. W.G.	0.1	0.1	0.1	
KW CAPACITY (min.)	2.5	4	7.5	
ELECTRIC CHARACTERISTICS:				
POWER: VOLTS/PHASE/HZ	480/3/60	480/3/60	480/3/60	
CONTROL: VOLTS/PHASE/HZ	120/1/60	120/1/60	120/1/60	
CONSTRUCTION:				
SIZE (H X W), INCHES	12 X 6	14 X 10	14 X 12	
FLANGED OR SLIP-IN	FLANGED	FLANGED	FLANGED	
EXPOSED NICHROME WIRE	YES	YES	YES	
ACCESSORIES:				
AIRFLOW SWITCH	YES	YES	YES	
FAN INTERLOCK RELAY	NO	NO	NO	
THERMAL CUT-OUT	YES	YES	YES	
MULTI-STEP CONTROLLER	YES	YES	YES	

REMARKS

*Furnished by Equipment Vendor

ATTACHMENT B
FIELD INSPECTION AND CHECKOUT CHECKLIST

ELECTRIC DUCT HEATERS

Equipment Number _____ Purchase Order No. _____

Location _____

Installed By _____ Mfr. _____

Specification No. _____ Rev. _____ Dwg. No. _____ Rev. _____

NOTES: 1) This checklist covers the general requirements for the inspection and testing of equipment for start-up. It should be used in conjunction with the manufacturer's installation, testing and operating instructions.
2) All test equipment and instrumentation shall be properly calibrated per manufacturer's instructions. Items out of calibration or damaged shall not be used for testing.
3) Record all defects, missing parts, etc., and action taken to correct.

Items to Inspect/Check/Test	Installation Meets Requirements Signature	Recorded Data Remarks
(Inspection/check/test procedures to be detailed in this section. Items should be listed in the order to be accomplished.)		

PROCEDURE APPROVAL — SELLER REPRESENTATIVE _____ DATE _____

PROCEDURE APPROVAL — BUYER'S REPRESENTATIVE _____ DATE _____

TEST COMPLETION ACKNOWLEDGEMENT — SELLER REPRESENTATIVE _____ DATE _____

TEST COMPLETION ACKNOWLEDGEMENT — BUYER'S REPRESENTATIVE _____ DATE _____

U.S. DEPARTMENT OF ENERGY
Hanford Waste Vitrification Plant
Richland, Washington
DOE Contract DE-AC06-86RL10838

FLUOR DANIEL, INC.
Advanced Technology Division
Fluor Contract 8457

SECTION 15840
DUCTWORK
B-595-C-E350-15840

APPROVED FOR CONSTRUCTION

REVISION 1 PER CR-0859
ISSUE DATE 8/4/93

WAPA YES ___ NO X
QUALITY LEVEL I ___ II X
SAFETY CLASS 1__ 2__ 3 X 4__

ORIGINATOR:

Behzad Entezam 7/8/93
B. Entezam, HVAC Engineer Date

CHECKER:

R. E. Flye 7.8.93
R. E. Flye, HVAC Engineer Date

APPROVED BY:

Manuel G. Mercado 7/14/93
M. G. Mercado Lead Discipline Engineer Date

SECTION 15840
DUCTWORK
B-595-C-E350-15840

TABLE OF CONTENTS

ATTACHMENTS

SECTION 15840
DUCTWORK

PART 1 GENERAL

1.1 SUMMARY

This section defines the minimum technical requirements for furnishing, installing and inspection of galvanized sheet metal steel and flexible ductwork systems.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE, INC. (ANSI)

ANSI B18.6.4	1981 (R91) Thread Forming and Thread Cutting Tapping Screws and Metallic Drive Screws (Inch Series)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A307	1990 Standard Specification for Carbon Steel Bolts and Studs 60,000 psi Tensile Strength
ASTM A527/A527M	1990 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock Forming Quality
ASTM A563	1991 Standard Specification for Carbon and Ally Steel Nuts
ASTM D1056	1985 Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 255	1990 Surface Burning Characteristics of Building Materials

SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION, INC. (SMACNA)

SMACNA	1985 HVAC Duct Construction Standards, Metal and Flexible, First Edition
SMACNA	1985 HVAC Air Duct Leakage Test Manual

UNDERWRITERS LABORATORIES, INC. (UL)

UL 181	1990 Standard for Safety Factory-Made Air Ducts and Air Connectors - Seventh Edition

1.3 **RELATED REQUIREMENTS**

Specification Section 05067	Welding HVAC System
Specification Section 05120	Structural Steel
Specification Section 09900	Painting
Specification Section 15258	Thermal Insulation for Ductwork and Piping

1.4 **DEFINITIONS**

(Not Used)

1.5 **SYSTEM DESCRIPTION**

(Not Used)

1.6 **SUBMITTALS**

Submit the following in accordance with the Vendor Drawing and Data Requirements section of the Order/Subcontract.

1.6.1 Plans and Elevations - Plans and elevations of ductwork systems including dimensions that indicate exact location with respect to building structure and including material of construction for sheet metal.

1.6.2 Size and Gauge - Size and gauge of ducts and plenums.

1.6.3 Reinforcements and Construction Details - Size and gauge of duct and plenum reinforcements and construction details.

1.6.4 Joints - Type and detail of longitudinal and transverse joint.

1.6.5 Fittings - Type and detail of fittings.

1.6.6 Accessories - Flexible connections, gaskets, locking quadrants, joint sealer, duct tape, and all other accessories.

1.6.7 Bill of Materials - Complete bill of materials.

1.6.8 Inspection and Checkout List

The Seller shall prepare a checklist for the inspection and checkout of the system ductwork using the format of Attachment A or other form that includes all the information requested in Attachment A. This checklist shall be submitted to the Buyer and shall include the following as a minimum:

A. Ductwork and accessories are installed in accordance with the contract drawings and this specification.

B. Ductwork has been leveled, aligned and securely anchored to supports.

C. All joints are properly constructed, sealed, and gasketed and were inspected before any insulation was installed.

D. All dampers are installed as shown on Contract Drawings.

E. All required flexible connections have been supplied and they are of the construction specified.

F. All duct mounted coils are installed as shown on Contract Drawings.

G. Ductwork is clean, undamaged, and free of foreign material.

H. Duct access doors are installed as shown on Contract Drawings and the doors and latches operate freely.

I. Ductwork systems are connected, anchored and have been checked for pressure and leakage integrity.

J. Ductworks are painted as required.

K. Ductworks are insulated as required.

L. Ductworks are properly labeled.

M. All required dampers (modulating, backdraft, and balancing) are installed correctly.

N. All ducting is of the required specified thickness and ducting reinforcement is correctly spaced.

1.6.9 Construction Acceptance Test (CAT)

A. Test result per Paragraph 3.3.1 of this specification.

B. Inspection and Testing per Paragraph 3.3.2 of this specification.

1.7 **CLASSIFICATION OF SYSTEM AND COMPONENTS**

(Not Used)

1.8 **PROJECT OR SITE ENVIRONMENTAL CONDITIONS**

(Not Used)

PART 2 PRODUCTS

2.1 **MATERIALS AND EQUIPMENT**

2.1.1 General

Ductwork and plenums shall be furnished and tested in accordance with this specification and the drawings which show the extent, requirements and general arrangement of the systems. The ducts shall include all fittings, plenums and accessories specified herein and as shown on the drawings. Ductwork system pressure classification of construction are noted on the Contract Drawings.

2.1.2 Ductwork Materials

2.1.2.1 Sheet Metal Ductwork and Plenum

Sheet metal for ductwork and plenums shall be G90 galvanized carbon steel in accordance with ASTM A527.

2.1.2.2 Ductwork Supports

Structural materials for duct support and plenum framing shall be in accordance with SMACNA duct construction standard and Specification Section 05120.

2.1.2.3 Fasteners

Fasteners including bolts, nuts, sheet metal screws, shall be zinc coated steel. Bolts and nuts shall be in accordance with ASTM A307 and ASTM A563 respectively. Sheet metal screws shall be in accordance with ANSI B18.6.4.

2.1.2.4 Flexible Connectors

Flexible connections shall be prefabricated duct connectors consisting of two 3 inch wide galvanized metal strips, connected longitudinally to each side of a strip of 3 inch wide fabric. Thickness of galvanized strips shall be same as the connecting duct work. Fabric shall be nylon base cloth with vinyl coating on both sides. Fabric weight shall be 15 ounces per square yard minimum. Tensile strength shall be 250 pounds per square inch. Fabric shall be air tight, water proof and resistant to oil and grease. Fabric to metal joints shall be of double fold seam type. Duct connectors shall be "Excelon" as fabricated by Duro-Dyne Corporation, or equal.

2.1.2.5 Gaskets

Gaskets for all access doors and flange type connections shall be minimum 1/4 inch thick full face closed cell, expanded neoprene sponge, grade SCE-43 in accordance with ASTM D1056 and NFPA 255, with cut surfaces on both faces.

2.1.2.6 Joint Sealer

Joint sealer shall be polymeric rubber with a hydrocarbon resin base and shall be UL listed and/or FM approved. The NFPA 255 flame spread rating and smoke developed rating shall not exceed 20, as manufactured by United Sheet Metal or equal.

2.1.2.7 Duct Tape

Duct tape shall be the plastic backed type. The duct tape and joint sealer, Paragraph 2.1.2.6 above, shall be compatible so as to cure together to form a bond. All duct and fitting joints except those which are welded or flanged and gasketed shall be taped.

2.1.2.8 Flexible Ductwork

A. Flexible duct shall be fully lined acoustical duct constructed of a flame retardant liner bonded to a galvanized spring wire helix with a fiberglass blanket bonded to the liner and complete with a fire-retardant vapor barrier jacket. Flexible duct shall be UL-181 Class I, air duct material listed and labeled, with a flamespread rating not exceeding 25 and a smoke-developed rating not exceeding 50. Insertion loss per linear foot of length at 250 Hz for a 16 inch diameter shall not be less than 3 decibels as demonstrated by an independent testing laboratory.

B. The flexible duct shall not exceed twelve (12) feet in length, and bends shall have a minimum radius of one and one-half times the diameter of the duct.

C. Duct connections shall be provided in accordance with SMACNA Duct Construction Standards, unless shown on the Contract Drawings.

D. Extractor spin collar fittings shall be provided for connecting round flexible ducts to rectangular sheet metal ducts. It shall be fabricated from hot-dipped galvanized steel and shall be provided with a factory installed balancing damper with a positive locking device.

2.1.2.9 Duct Insulation

Duct insulation shall be in accordance with Specification Section 15258.

2.1.3 Ductwork Constructions

2.1.3.1 Ductwork construction, material gauge, and reinforcement spacing and type shall be in accordance with SMACNA Duct Construction Standard unless noted on the Contract Drawings.

2.1.3.2 Ductwork structural steel supports construction shapes and sizes shall be in accordance with SMACNA Duct Construction Standard unless noted on the Contract Drawings.

2.1.3.3 Elbows in rectangular ductwork shall be the standard radius elbow having inside radius equal to its width, unless otherwise noted on the Contract Drawings. Where square elbows are to be furnished, turning vanes of the double vaned type construction shall be provided, fabricated in accordance with SMACNA Duct Construction Standard.

2.1.3.4 Elbows in round ducts shall be constructed in accordance with guidelines stated in Section 111 of the SMACNA Duct Standards and as shown on the Contract Drawings. Elbows shall have a centerline radius equal to 1-1/2 times diameter of duct unless otherwise shown on Contract Drawings. Short radius elbows, where indicated, shall have a centerline radius equal to the duct diameter.

2.1.3.5 Air Extractors shall be of the adjustable type and shall be installed at each duct takeoff from the main duct and at each register takeoff unless noted otherwise on the Contract Drawings. Air extractors shall be constructed and installed per SMACNA Standard. Adjustment shall be done by means of an adjustment arm which shall be fastened to the ductwork after the adjustment of the extractor position.

2.1.3.6 Duct access doors or panels shall be provided and installed as shown on the Contract Drawings. Doors shall be the double wall construction type equipped with 1/4 inch thick by 3/4 inch wide neoprene gasketing that shall prevent leakage of air under operating conditions when in the closed position. Access door construction shall conform to SMACNA Duct Construction Standard.

2.1.3.7 Welding - All welding shall be done in accordance with Specification Section 05067.

2.2 **FABRICATION AND MANUFACTURE**

(Not Used)

2.3 **LABELING**

Each system ductwork shall be clearly marked as supply, return, exhaust or outside air intake as it is shown on the Contract Drawings. Markings shall be with waterproof ink, paint, or other indelible material.

2.4 **PACKAGING**

Preparation for shipment and packing shall conform to the manufacturer's standards and shall provide protection against corrosion and damage from normal handling. Preparation shall include the following:

2.4.1 Temporary bracing, supports, and rigging connections shall be provided as necessary to prevent damage during shipment, lifting, and unloading.

2.4.2 End covers shall be provided to protect the duct interior during storage.

2.4.3 Separate or loose parts shall be completely boxed and attached to the main device and shipped as a unit. All shipping boxes shall be identified by the duct class number, Seller's purchase order number, description of the ductwork, Seller's name, project identification, and destination with ink, paint, or other indelible material. A copy of the packing list shall be securely affixed to the outside of each package or crate.

PART 3 EXECUTION

3.1 **PREPARATION**

Before installation, Seller shall review all pertinent documentation and verify the following:

3.1.1 All documentation (data and drawings) required by Paragraph 1.6 of this specification has been submitted to the Buyer.

3.1.2 The Seller has received from the Buyer approved specifications and Contract Drawings covering all ductwork and accessories to be installed.

3.1.3 Each duct is complete with all accessories.

3.1.4 All openings for the duct system are of the size and in the location shown on the Contract Drawings.

3.1.5 All openings are clear of all foreign matter which might interfere with the installation of the ductwork or accessories.

3.1.6 The material is of the type and thickness specified herein.

3.2 **INSTALLATION, APPLICATION AND ERECTION**

3.2.1 Install ductwork in accordance with the Contract Drawings and the SMACNA Standards referenced in this specification.

3.2.1.1 Ductwork Systems

A. Supports

Installation of duct supports shall be in accordance with SMACNA Duct Construction Standard unless indicated on Contract Drawings.

B. Instrument Connections

Instrument connections shall be of the size and construction and in the location as shown on the Contract Drawings.

C. Doors

Access doors and access panels shall be sized and located as shown on the Contract Drawings.

D. Transitions

Changes in the size of ducts and offsets shall be made gradually with a slope of not more than three to one unless otherwise noted on Contract Drawings.

E. Ductwork Insulation

Material and insulation of ductwork thermal insulation shall be in accordance with Specification Section 15258 and as shown on Contract Drawings.

F. Flexible Duct Installation

Install duct in fully extended condition as far as practical, using only the minimum length required to make the connection. Installation of ducts in compressed or partially compressed condition will not be allowed. Provide support for the flexible ducts per manufacturer recommended intervals but at no greater distance than 10 feet. Maximum permissible sag shall be 1/2 inch per foot of spacing between support.

G. Round Duct

Horizontal round duct shall be installed with longitudinal seams on top.

H. Welding

Welding shall be in accordance with Specification Section 05067.

3.2.1.2 Surface Painting and Coating

3.2.1.2.1 Structural members shall be cleaned and coated in accordance with Specification Section 09900.

3.2.1.2.2 Galvanized coatings shall be touched-up or repaired in accordance with Specification Section 09900 wherever original coating has been damaged.

3.3 **FIELD QUALITY CONTROL**

3.3.1 Leak Testing

3.3.1.1 Upon completion of installation of the ductwork system and prior to installation of duct insulation the system shall be leak tested in accordance with SMACNA HVAC Air Duct Leakage Test Manual. System test pressure shall be 1.5 times the duct pressure classification shown on the Contract Drawing. Duct leakage rate during the test shall not exceed 5% of the total design airflow for each system or portion of the system under test.

3.3.1.2 Test results shall be documented and evaluated by a responsible authority (Seller) to assure that test requirements have been satisfied. Test documents shall be included in the submittal requirement of this specification.

3.3.1.3 Test records shall contain the following information as a minimum:

A. System tested.

B. Date of test.

C. Equipment, instrumentation and recorder used.

D. Type of observation.

E. Results and acceptability.

F. Action taken in connection with any deviations noted.

G. Name(s) and title of person(s) evaluating test results.

3.3.1.4 Test results shall be submitted to the Buyer for review and approval.

3.3.2 Inspection and testing shall be performed as required by field inspection and checkout checklist (Attachment A).

3.4 **ADJUSTMENTS**

(Not Used)

3.5 **CLEANING**

(Not Used)

3.6 **PROTECTION**

(Not Used)

3.7 **DEMONSTRATION**

(Not Used)

3.8 **SCHEDULES**

(Not Used)

END OF SECTION

ATTACHMENT A
FIELD INSPECTION AND CHECKOUT CHECKLIST

DUCTWORK

Equipment Number _____ Purchase Order No. _____

Location _____

Installed By _____ Mfr. _____

Specification No. _____ Rev. _____ Dwg. No. _____ Rev. _____

NOTES: 1) This checklist covers the general requirements for the inspection and testing of equipment for start-up. It should be used in conjunction with the manufacturer's installation, testing and operating instructions.
2) All test equipment and instrumentation shall be properly calibrated per manufacturer's instructions. Items out of calibration or damaged shall not be used for testing.
3) Record all defects, missing parts, etc., and action taken to correct.

Items to Inspect/Check/Test	Installation Meets Requirements Signature	Recorded Data Remarks
(Inspection/check/test procedures to be detailed in this section. Items should be listed in the order to be accomplished.)		

PROCEDURE APPROVAL SELLER REPRESENTATIVE _____ DATE _____

BUYER'S REPRESENTATIVE _____ DATE _____

TEST COMPLETION ACKNOWLEDGEMENT SELLER REPRESENTATIVE _____ DATE _____

BUYER'S REPRESENTATIVE _____ DATE _____

U.S. DEPARTMENT OF ENERGY
Hanford Waste Vitrification Plant
Richland, Washington
DOE Contract DE-AC06-86RL10838

FLUOR DANIEL, INC.
Advanced Technology Division
Fluor Contract 8457

SECTION 15861
DAMPERS
B-595-C-E350-15861

APPROVED FOR CONSTRUCTION

REVISION 1 PER CR-0859
ISSUE DATE 8/4/93

WAPA YES ___ NO X
QUALITY LEVEL I ___ II X
SAFETY CLASS 1__ 2__ 3 X 4__

ORIGINATOR:

Behzad Entezam 7,8,93
B. Entezam, HVAC Engineer Date

CHECKER:

R. E. Flye 7.8.93
R. E. Flye, HVAC Engineer Date

APPROVED BY:

Manuel G. Mercado 7/14/93
M. G. Mercado Lead Discipline Engineer Date

SECTION 15861
DAMPERS
B-595-C-E350-15861

TABLE OF CONTENTS

ATTACHMENTS

SECTION 15861
DAMPERS

PART 1 GENERAL

1.1 SUMMARY

This section defines the minimum technical requirements for furnishing, installing, testing and checking out manual dampers, automatic dampers, backdraft dampers, butterfly valves, and pressure relief dampers for heating, ventilating, and air conditioning systems.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AIR MOVING AND CONDITIONING ASSOCIATION (AMCA)

AMCA Standard 500	1989 Test Method for Louvers, Dampers and Shutters

AMERICAN NATIONAL STANDARD INSTITUTE, INC. (ANSI)/
NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI/NEMA 250	1985 Enclosures For Electrical Equipment (1000 Volt Maximum) - (Revision 1 - 1986, Revision 2 - 1988)

1.3 RELATED REQUIREMENTS

Specification Section 01730	Operation and Maintenance Data
Specification Section 17703	Instrument Piping Materials
Specification Section 17864	Instrument Furnished with Mechanical Equipment Canister Storage Building

1.4 DEFINITIONS

1.4.1 For purposes of this specification, the following definitions shall apply:

A. The term "manual damper" shall be defined to mean a damper which is operated manually without the assistance of a motorized operator.

B. The term "automatic damper" shall be defined to mean a damper which is operated with a motorized operator. This would include both pneumatic and electric operators.

C. The term "backdraft damper" shall be defined to mean a "gravity actuated damper," or one that closes when there is no airflow.

1.5 **SYSTEM DESCRIPTION**

(Not Used)

1.6 **SUBMITTALS**

Submit the following in accordance with the Vendor Drawing and Data Requirements section of the Order/Subcontract.

1.6.1 Literature - Provide descriptive literature and catalog sheets for each damper and/or component with manufacturer's name, model number(s), shipping weight and operating weight.

1.6.2 Dimensional Outline Drawings - The drawings shall include:

A. Plan views and assembly drawings.

B. Sectional views showing internal arrangement of components.

C. Overall dimensions and interfacing dimensions.

D. Mounting of operators and positioners to dampers.

E. Mounting requirements for damper/valve assembly.

F. Flow direction installation if required.

G. Fail position if equipped with motorized operator.

H. Piping, electrical, and instrumentation connection sizes and locations.

1.6.3 Factory Acceptance Test (FAT) - Test report in accordance with Paragraph 2.1.1.3 of this specification.

1.6.4 Performance Data - Performance data including tables and curves and data, such as air pressure drop, leakage, and torque.

1.6.5 Control Diagrams - Complete control diagrams, wiring diagrams and electrical schematic diagrams with power voltage and amperage ratings.

1.6.6 Parts List and Spare Parts List - A complete parts list and a list of manufacturer's recommended spare parts. Include sufficient information to permit procurement of parts from the manufacturer or any subsupplier.

1.6.7 Installation, Operating, and Maintenance Instructions - Detailed installation, operating, and maintenance instructions shall be submitted in accordance with Specification Section 01730, Operation and Maintenance Data.

1.6.8 Inspection and Checkout List

The Seller shall prepare a checklist for the inspection and checkout of the dampers/valves using the format of Attachment B or other form that includes all the information requested in Attachment B. This checklist shall be submitted to the Buyer and shall include the following as a minimum:

A. Check that damper and operator assembly is undamaged, clean and free of foreign material.

B. Check that equipment bearings are lubricated in accordance with manufacturer's recommendation.

C. Check that damper blades are in alignment and rotate freely.

D. Check that damper assembly are installed complete with all the required accessories as specified.

E. Check that air line connections are tight.

F. Damper operators limit switches and linkages are properly installed.

1.6.9 Construction Acceptance Test (CAT) - Inspection and Testing per Paragraph 3.3.1 of this specification.

1.7 **CLASSIFICATION OF SYSTEM AND COMPONENTS**

(Not Used)

1.8 **PROJECT OR SITE ENVIRONMENTAL CONDITIONS**

(Not Used)

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 General

2.1.1.1 Each damper and valve covered by this specification shall be supplied as fully shop assembled with all the required accessories and shall be shop tested as a unit. Each packaged unit shall be shipped to the site, ready to be installed without any further field assembly.

2.1.1.2 Damper frames shall have 2 inch minimum flanges turned to the outside for connection to ductwork and equipment. The flanges shall be reinforced with flat stock of the same type of material as the damper frame so that frame and reinforcement have a combined minimum thickness of 1/4 inch. 7/16 inch diameter holes shall be drilled in the flanges to match the connecting ductwork or equipment, 4 inch maximum center-to-center spacing of bolt holes.

2.1.1.3 Factory Acceptance Test

2.1.1.3.1 Prior to shipment to the site, dampers shall be tested for leakage performance herein as indicated. The manufacturer shall also test each damper and operator assembly as a package to verify its proper operation. The assembly shall operate smoothly without any binding and deformation. Each assembly shall be fully stroked at least fifteen times.

2.1.1.3.2 Test procedures shall be documented and shall be included in the submittal of the test results as indicated below.

2.1.1.3.3 Test records shall contain the following information as a minimum:

1) Damper tested
2) Date of test
3) Equipment, instrumentation and data recorder used
4) Type of observation
5) Results and acceptability
6) Action taken in connection with any deviations noted, if any
7) Name(s) and title of person(s) evaluating test results.

2.1.1.3.4 Test results shall be evaluated by a responsible authority (Seller) to assure that test requirements are satisfied. Test results shall be submitted to the Buyer for review and approval.

2.1.2 Manual Dampers

2.1.2.1 Type I Dampers

2.1.2.1.1 Dampers shall be opposed blade type unless noted on the drawings.

2.1.2.1.2 Dampers shall be of the following channel frame construction:

A. 10 inches x 2 inches x 14 gauge galvanized steel through 48 inches width or length.

B. 10 inches x 2 inches x 12 gauge galvanized steel, 49 inches through 75 inches width or length.

C. 10 inches x 2 inches x 10 gauge galvanized steel, 76 inches through 96 inches width or length.

2.1.2.1.3 Damper blades shall be flat type. Blade construction material shall be as follows:

A. 16 gauge galvanized steel through 36 inches length.

B. 12 gauge galvanized steel from 37 inches through 48 inches length.

2.1.2.1.4 Damper blades shall have maximum blade width of 9-1/2 inches. Blade shall not protrude out of the frame when in fully open position. Damper blades with length up to 36 inches shall be provided with locking quadrant. Damper blades with length of 37 inches through 48 inches shall be provided with manual operator for ease of operation.

2.1.2.1.5 Blade axles shall be full length construction per the following:

A. 1/2 inch diameter galvanized steel for 36 inches long blades.

B. 3/4 inch diameter steel from 37 inches through 48 long blades.

2.1.2.1.6 Drive axles shall be as follows:

Axle Diameter and Type	Max Damper Face Area (ft^2)
1/2 inch diameter galvanized steel	Less than 10
3/4 inch diameter carbon steel	11 - 35
1 inch diameter carbon steel	36 and Over

Drive axles shall be of full blade length extending through mullions for multipanel dampers.

2.1.2.1.7 Bearings shall be oil impregnated bronze or permanently lubricated ball or roller bearings.

2.1.2.1.8 Linkage shall have plated steel brackets and brass or stainless steel sleeve with 5/16 inch diameter galvanized steel rod, or equivalent flat bar.

2.1.2.1.9 Dampers shall be provided with external blade position indicators. The indicator shall indicate with graduations 0, 25, 50, 75, and 100 percent open position of the damper. The indicator shall be mounted on the same side as the quadrant/operator. The position indicator shall be a pointed galvanized steel strip, minimum 6 inches long and 0.125 inch thick.

2.1.2.1.10 Pressure drop shall not exceed 0.80 inch water gauge at the full open position at a face velocity of 3000 feet per minute. Leakage shall not exceed 35 cubic feet per minute per square foot at 1 inch water gauge differential pressure and a temperature of 70°F with a minimum of 128 inch pound of torque applied to the damper shaft. Data shall be based on a 42 inches square sample tested in accordance with AMCA Standard 500, Section 8.2 (pressure drop) and Section 8.3 (leakage).

2.1.2.1.11 Damper shall be able to withstand minimum velocity of 6000 feet per minute without the loss operation, blade fluttering or structural damage.

2.1.2.1.12 Damper shall be able to withstand minimum differential pressure of 5 inches water gauge without the loss of operation or structural damage.

2.1.2.2 Type II Dampers

2.1.2.2.1 Dampers shall be opposed blade type unless noted on the drawings.

2.1.2.2.2 Dampers frames shall be of the following channel frame construction:

A. 10 inches x 2 inches x 10 gauge galvanized steel channel through 60 inches width or length.

B. 10 inches x 2-1/2 inches x 3/16 inch galvanized steel channel from 61 inches through 80 inches width or length.

C. 10 inches x 2-1/2 inches x 3/16 inch galvanized steel channel from 61 inches through 80 inches width or length.

2.1.2.2.3 Damper blades shall be of weld-free air foil design, through-bolted to the axles. Blade construction material shall be as follows:

A. 16 gauge galvanized steel through 32 inches damper frame width.

B. 14 gauge galvanized steel from 33 inches through 48 inches damper frame width.

C. 12 gauge galvanized steel from 49 inches through 96 inches damper frame width.

2.1.2.2.4 Damper blades shall have maximum blade width of 11-1/2 inches. Blades shall not protrude out of the damper frame when in fully open position. Damper blades with length up to 36 inches shall be provided with locking quadrant. Damper blades with length of 37 inches and above shall be provided with manual operators for ease of operation.

2.1.2.2.5 Blade axles shall be full length construction per the following:

A. 3/4 inch diameter carbon steel for 32 inches long blades.

B. 1 inch diameter steel for 33 inches through 48 inches long blades.

C. 1-1/4 inches diameter steel for 49 inches through 60 inches long blades.

D. 1-1/2 inches diameter steel for 61 inches through 74 inches long blades.

E. 1-3/4 inches diameter steel for 75 inches through 88 inches long blades.

F. 2 inches diameter steel for 89 inches through 96 inches long blades.

2.1.2.2.6 Linkage shall be located outside the air stream in the damper channel frame.

2.1.2.2.7 Bearings shall be oil impregnated bronze sleeve type or permanently lubricated ball or roller type.

2.1.2.2.8 Dampers shall be provided with stainless steel blade seals and frame seals.

2.1.2.2.9 Pressure drop shall not exceed 1.28 inches wg. at full open position and at a face velocity of 3000 feet per minute. Leakage shall not exceed 7 cubic feet per minute per square foot at 1 inch

differential pressure and a temperature of 70°F with a minimum 337 in/lb torque applied to the drive axle. Data shall be based on a 42 inches square sample tested in accordance with AMCA Standard 500, Section 8.2 (pressure drop) and Section 8.3 (leakage).

2.1.2.2.10 Dampers shall be equipped with external blade position indicators which shall indicate with graduations 0, 25, 50, 75, and 100 percent open position of the damper. The position indicator shall be mounted on the same side as the operator. The position indicator shall be a pointed galvanized steel strip minimum 6 inches long and 0.125 inch thick.

2.1.2.2.11 Dampers shall be able to withstand minimum velocity of 6000 feet per minute without loss of operation, blade flutter and structural damage.

2.1.2.2.12 Dampers shall be able to withstand a minimum differential pressure of 12 inches water gauge without loss of operation and structural damage.

2.1.3 Automatic Dampers

2.1.3.1 Type I Dampers

2.1.3.1.1 Automatic dampers (Type I) shall be of similar construction and performance as the manual dampers (Type I) except they shall be furnished with pneumatic operators or electric operators as noted on the data sheets.

2.1.3.1.2 Pneumatic Damper Operators

A. Pneumatic damper operators, including the accessories such as positioners and limit switches, shall be furnished, installed, and piped on the automatic dampers by the damper supplier prior to shipment to the site.

B. Pneumatic damper operators shall be piston or diaphragm type multipositioning device used primarily for operating ventilating dampers in response to pneumatic signal. A two-way swivel connection on the operator cylinder head shall be provided to ensure nonbinding movement.

C. Pneumatic damper operators shall be designed for maximum supply air pressure of 30 psig and shall have an operating range of 3 to 15 psig. The positioners shall be suitable for input signal range of 3 to 15 psig, the output signal pressure shall be suitable to maintain damper in the correct position. The positioner action shall be field reversible.

D. Pneumatic damper operators and positioners shall be selected by the damper manufacturer based on information provided on the data sheet and suitability to the dampers. Use of multiple operators for damper operation shall be limited unless it is required to properly operate large dampers.

2.1.3.1.3 Electric Damper Operators

A. Electric damper operators shall be two position spring returning type or modulating type industrial control motor. Motor rating shall be 120 volts, 1-phase, 60 Hz, or 24 volts, 1-phase, 60 Hz with built-in transformer.

B. Electric damper operators shall be mounted on the dampers by the damper manufacturer prior to shipment to the site.

C. Electric damper operator shall be selected by the damper manufacturer based on information provided on the data sheet and its suitability to the dampers. Use of multiple operators for damper operation shall be limited unless it is required to properly operate large dampers.

2.1.3.1.4 Damper linkage shall be rated for a minimum of 200 percent of the maximum operator torque.

2.1.3.1.5 Limit switches, where identified on the data sheets, shall have DPDT snap action contacts rated for 120 Vac, 60 Hz, 5 ampere noninductive load. Limit switch shall be actuated by the damper shaft movement. Switches shall be normally open type. Switch contacts and wiring terminals shall be enclosed in a NEMA-4 enclosure in accordance with NEMA-250. Limit switches shall be furnished and installed by the damper supplier prior to shipment to the site . Limit switches shall be Honeywell Microswitch Heavy Duty Limit (HDLS) type or equal.

2.1.3.1.6 Solenoid valves and transducers are provided in accordance with Specification Section 17864.

2.1.3.2 Type II Dampers

2.1.3.2.1 Automatic dampers (Type II) shall be of similar construction and performance as the manual dampers (Type II) except they shall be furnished with pneumatic actuators and other accessories as specified herein.

2.1.3.2.2 Pneumatic Damper Operators

A. Pneumatic damper operators and accessories shall be furnished and installed on the automatic dampers by the damper supplier prior to shipment to the site, including damper-operator linkages. Interconnecting tubing shall be copper

tubing as per Specification Section 17703, Material Class ZY. The pneumatic damper operators shall be mounted to remain fixed. No swivel movement of the damper operator shall be allowed. Pneumatic damper operators that attach directly to damper shaft shall be provided with two keyways such that damper operator can be rotated 90 degrees. Damper and operator mounting detail shall be submitted to the Buyer for approval.

B. Pneumatic damper operators shall be equipped with all the accessories as noted on the data sheets.

C. Pneumatic damper operators and positioners shall be capable of operation with supply air pressure up to 150 psig.

D. The positioners shall be suitable for input signal range of 3 to 15 psig, the output signal pressure shall be suitable to maintain damper in the correct position. The positioner action shall be field reversible.

E. Filter regulator airsets shall be supplied, mounted, and piped for the positioners. Each filter regulator airsets shall be of all metal construction and shall be provided with internal relief and an output pressure gauge.

F. The positioners hysteresis shall not exceed 0.15 percent of total stroke or instrument span, the resolution shall be minimum 0.2 percent of the instrument span and repeatability minimum shall be 0.3 percent of total stroke or instrument pressure span.

G. Pneumatic damper operators and positioners shall be suitable for ambient temperature -30°F to 150°F.

H. Pneumatic damper operators with handwheels shall have declutching mechanism. Handwheels shall enable manual operation of the damper from fully open position to fully closed position and vice-versa. The handwheel shall not rotate during automatic operation of the operator.

I. Pneumatic damper operators shall be selected by the damper manufacturer based on information provided on the data sheet and suitability to the dampers. Use of multiple operators for damper operation shall be limited unless it is required to properly operate large dampers.

2.1.3.2.3 Damper linkage shall be rated for a minimum of 200 percent of the maximum operator torque.

2.1.3.2.4 Limit switches, where identified on the data sheets shall be provided per Paragraph 2.1.3.1.5 of this specification.

2.1.3.2.5 Solenoid valves and transducers are provided in accordance with Specification Section 17864.

2.1.4 Backdraft Dampers

2.1.4.1 Type I Damper

2.1.4.1.1 Damper shall be able to withstand face velocity of 4000 feet per minute without the loss of operation, blade fluttering and deformation.

2.1.4.1.2 Damper shall be able to withstand differential pressure of 5 inches water gauge without the loss of operation, deformation or structural damage.

2.1.4.1.3 Pressure drop shall not exceed 0.50 inches water gauge at a face velocity of 3000 feet per minute. Leakage shall not exceed 18 cubic feet per minute per square foot at 1 inch water gauge differential pressure and a temperature of 70°F. Performance shall be based on a 24 inches square sample tested in accordance with AMCA Standard 500, Section 8.2 (pressure drop) and Section 8.3 (leakage). Test results shall be submitted to the Buyer for approval.

2.1.4.1.4 Damper frame construction shall be as follows:

A. 10 inches x 2 inches x 14 gauge galvanized steel channel through 48 inches width or length.

B. 10 inches x 2 inches x 12 gauge galvanized steel channel from 49 inches through 75 inches width or length.

C. 10 inches x 2 inches x 10 gauge galvanized steel channel from 76 inches through 96 inches width or length.

Damper blades and linkage shall not extend out of the frame at full open position.

2.1.4.1.5 Damper blades construction shall be as follows:

A. 16 gauge galvanized steel through 33 inches length.

B. 12 gauge galvanized steel from 34 inches through 48 inches length.

C. Over 48 inches long - 10 gauge galvanized steel.

Blades over 48 inches in length shall be provided with intermediate supports with bearings. the intermediate support mullion shall be 3-1/2 inches x 1 inch x 16 gauge galvanized steel hat channel.

2.1.4.1.6 Axles shall be as follows:

A. 1/2 inch diameter galvanized steel stub for blades through 28 inches length.

B. 1/2 inch diameter galvanized steel full length from 29 inches through 33 inches long blades.

C. 3/4 inch diameter steel stub from 34 inches through 48 inches blade length.

D. 3/4 inch diameter steel full length from 41 inches through 48 inches blade length.

All axles with counterbalancing arms shall be of full length.

2.1.4.1.7 Bearings shall be press fit ball bearings. Sleeve bearings shall not be used.

2.1.4.1.8 Dampers shall have 16 gauge galvanized steel stops.

2.1.4.1.9 Damper blades shall be equipped with neoprene rubber seals or equal. Jambs shall have Ethylene Propylene Terpolymer (EPT) sponge seals or equal.

2.1.4.1.10 Damper blade shall be flat type.

2.1.4.2 Type II Dampers

2.1.4.2.1 Damper shall be suitable for face velocity of 4000 feet per minute without loss of operation, blade flutter or structural damage.

2.1.4.2.2 Damper shall be able to withstand differential pressure of 12 inches water gauge without loss of operation and structural damage.

2.1.4.2.3 Pressure drop shall not exceed 0.40 inches wg. 3000 feet per minute face velocity. The leakage shall not exceed 10 cubic feet per minute per square foot at 1 inch wg. differential pressure and a temperature of 70°F. Performances shall be based on tests in accordance with AMCA Standard 500, Section 8.2 (pressure drop) and Section 8.3 (leakage). Test results shall be submitted to the Buyer for approval.

2.1.4.2.4 Damper frame construction shall be as follows:

A. 10 inches x 2 inches x 10 gauge galvanized steel channel through 60 inches width or length.

B. 10 inches x 2-1/2 inches x 3/16 inch steel channel for 61 inches through 80 inches width or length.

C. 10 inches x 2-1/2 inches x 1/4 inch steel channel for 81 inches through 96 inches width or length.

2.1.4.2.5 Blade construction shall be as follows:

A. 16 gauge galvanized steel through 32 inches blade length.

B. 14 gauge galvanized steel over 32 inches blade length.

2.1.4.2.6 Blades shall remain within the damper frame when fully open.

2.1.4.2.7 Axles shall be 3/4 inch diameter steel full length of the blades.

2.1.4.2.8 Linkage shall be located outside the air stream in the damper channel frame and shall be rated for a minimum of 200 percent of the maximum operator torque.

2.1.4.2.9 Bearings shall be permanently lubricated roller or ball.

2.1.4.2.10 Damper blades shall be equipped with neoprene rubber or equal. Jambs shall have Ethylene Propylene Terpolymer (EPT) sponge seals or equal.

2.1.4.2.11 Dampers shall be counterbalanced for easy opening.

2.1.4.2.12 Damper blades shall be airfoil type.

2.1.5 Butterfly Valves

2.1.5.1 Butterfly valves shall be carbon steel construction. All surfaces in contact with the air stream shall be galvanized.

2.1.5.2 Flanges, sleeves, blades and shafts shall be of the following dimensions:

Valve Size (inches)	Flange Size (inches)	Sleeve Thickness (inches)	Blade Thickness (inches)	Shaft Diameter (inches)
6 to 16	3/16 x 2	0.134	0.187	3/4
17 to 24	1/4 x 2	0.187	0.187	1
25 to 42	1/2 x 2	0.250	0.250	1-1/2
43 to 60	1/2 x 2	0.250	0.50	2

2.1.5.3 Automatic valve actuators for butterfly valves shall be the same as specified in Paragraph 2.1.3.2 of this specifications.

2.1.5.4 Bearings shall be oil impregnated bronze sleeve type or permanently lubricated ball or roller type.

2.1.5.5 Pressure drop across the valve shall not exceed 0.3 inch water gauge at a velocity of 3000 feet per minute.

2.1.6 Pressure Relief Dampers

2.1.6.1 Pressure relief dampers shall be suitable for maximum velocity of 3000 feet per minute without loss of operation, blade flutter or structural damage.

2.1.6.2 Pressure relief dampers shall be suitable for maximum differential pressure of 5 inches water gauge without loss of operation or structural damage. Air leakage shall be limited to 1 percent of rated flow and a differential pressure of 2 inches water gauge.

2.1.6.3 Minimum start to open differential pressure shall be 0.25 inch water gauge. Maximum start to open differential pressure shall be 4 inches water gauge. Start to open differential pressure shall be field adjustable.

2.1.6.4 Damper frame shall be of the following constructions:

A. 10 inches x 2 inches x 12 gauge galvanized steel channel through 55 inches width or length.

B. 10 inches x 2 inches x 10 gauge galvanized steel channel from 56 inches through 75 inches width or length.

C. 10 inches x 2 inches x 3/16 inch galvanized steel channel for 76 inches through 90 inches width or length.

2.1.6.5 Blades shall be 16 gauge galvanized steel. Blades and linkage shall not protrude out of the damper frame when in full open position.

2.1.6.6 Axles shall be 3/4 inch diameter steel, full length.

2.1.6.7 Linkage can be located inside the air stream.

2.1.6.8 Limit switches where identified on the data sheets shall be as described in Paragraph 2.1.3.1.5 above.

2.2 FABRICATION AND MANUFACTURE

(Not Used)

2.3 LABELING

In addition to the manufacturer's identification nameplate, each unit shall be supplied with a corrosion-resistant metal tag identification in accordance with Specification Section 15196, Paragraph 2.2.2.9.

2.4 **PACKAGING**

Preparation for shipment and packing shall conform to the manufacturer's standards and shall provide protection against corrosion and damage from normal handling. Preparation shall include the following:

2.4.1 Machined surfaces and threads shall be protected during shipment by application of grease or other suitable rust prohibiting compound.

2.4.2 Dampers shall be suitably protected to prevent damage during shipment. All piping openings shall be plugged or capped to prevent contamination.

2.4.3 Temporary bracing, supports, and rigging connections shall be provided as necessary to prevent damage during shipment, lifting, and unloading.

2.4.4 Separate or loose parts shall be completely boxed and attached to the main device and shipped as a unit. All shipping boxes shall be identified by the component number(s), Seller's purchase order number, description of the equipment, manufacturer's name, Seller's name, project identification, and destination with ink, paint or other indelible material. A copy of the packing list shall be securely affixed to the outside of each package or crate.

PART 3 EXECUTION

3.1 **PREPARATION**

Before installation, Seller shall review all pertinent documentation and verify the following:

3.1.1 All documentation (data and drawings) required by Paragraph 1.6 of this specification has been submitted to the Buyer.

3.1.2 The Seller has received from the Buyer approved specifications and Contract Drawings covering all dampers/valves and accessories to be installed.

3.1.3 Inspect each damper/valve to make sure that it is of the proper size and provided complete with all accessories including operators where specified.

3.1.4 Inspect each damper unit to make sure that it is properly labeled.

3.1.5 Inspect the location where each damper is to be positioned to make sure that the damper opening and/or companion flanges are in accordance with the Contract Drawings.

3.2 **INSTALLATION, APPLICATION AND ERECTION**

3.2.1 Install each damper in accordance with the manufacturer's instructions, this specification and the Contract Drawings. Each damper assembly shall be squared vertically and horizontally during installation. The damper assembly shall not be twisted or forced into position.

3.2.2 Damper operators shall be installed in an accessible location and shall be secured in a manner to prevent screws and bolts from obstructing blade rotation. All operators shall be mounted on the damper shaft and shall be restrained to prevent vibration and movement under airflow.

3.2.3 Where dampers are mounted within the ductwork, the dampers shall be joined to the ductwork by flanged connections and the flanged joint shall be gasketed and sealed.

3.2.4 The Seller shall touch-up coating on dampers and accessories to match manufacturer's factory coating where it has been disturbed.

3.3 **FIELD QUALITY CONTROL**

3.3.1 Inspection and testing shall be performed as required by field inspection and checkout checklist (Attachment B).

3.4 **ADJUSTMENTS**

(Not Used)

3.5 **CLEANING**

(Not Used)

3.6 **PROTECTION**

(Not Used)

3.7 **DEMONSTRATION**

(Not Used)

3.8 **SCHEDULES**

(Not Used)

END OF SECTION

ATTACHMENT A
DATA SHEET E350-DS-1
AUTOMATIC DAMPERS

PROJ/BLDG : HWVP / CANISTER STORAGE BLDG.
SPEC NO. : B-595-C-E350-15861
PREPARED BY : B. ENTEZAM
CHECKED BY : R FLYE

EQUIPMENT NAME: MIXING BOX MODULATING DAMPER
EQUIPMENT NO.: DN-05I-111A & DN-05I-111B

SELECTION:		PERFORMANCE :	
MANUFACTURER	*	PRESSURE DROP, IN. W.G. (max.)	SEE SPEC.
MODEL NO.	*	LEAKAGE, CFM AT DESIGN FLOW	SEE SPEC.
QUANTITY REQUIRED	2		
SIZE (WIDTH X LENGTH), INCHES	12 X 30	OPERATOR SPECIFICATIONS :	
TYPE:		MANUFACTURER	*
MULTIBLADE	YES	MODEL NO.	*
AUTOMATIC	TYPE I	SIZE	*
BLADE ACTION :		PNEUMATIC	YES
OPPOSED OR PARALLEL	OPPOSED		
BLADE:			
TYPE	FLAT	ACCESSORIES :	
LINKED TOGETHER	YES	LIMIT SWITCH	YES
PARALLEL TO SHORT/LONG SIDE	SHORT	POSITIONER	YES
FRAME :			
FLANGED	YES		

REMARKS:

*FURNISHED BY EQUIPMENT VENDOR

ATTACHMENT A
DATA SHEET E350-DS-2
AUTOMATIC DAMPERS

PROJ/BLDG : HWVP / CANISTER STORAGE BLDG.
SPEC. NO. : B-595-C-E350-15861
PREPARED BY : B. ENTEZAM B.E.
CHECKED BY : R. FLYE

EQUIPMENT NAME: MIXING BOX MODULATING DAMPER
EQUIPMENT NO.: DN-05I-112A, DN-05I-112B, DN-05I-113A & DN-05I-113B

SELECTION:		PERFORMANCE :	
MANUFACTURER	*	PRESSURE DROP, IN. W.G. (max.)	SEE SPEC.
MODEL NO.	*	LEAKAGE, CFM AT DESIGN FLOW	SEE SPEC.
QUANTITY REQUIRED	4		
SIZE (WIDTH X LENGTH), INCHES	18 X 90	OPERATOR SPECIFICATIONS :	
TYPE:		MANUFACTURER	*
MULTIBLADE	YES	MODEL NO.	*
AUTOMATIC	TYPE I	SIZE	*
BLADE ACTION:		PNEUMATIC	YES
OPPOSED OR PARALLEL	OPPOSED		
		ACCESSORIES:	
		LIMIT SWITCH	YES
		POSITIONER	YES
BLADE:			
TYPE	FLAT		
LINKED TOGETHER	YES		
PARALLEL TO SHORT/LONG SIDE	SHORT		
FRAME:			
FLANGED	YES		

REMARKS:

*FURNISHED BY EQUIPMENT VENDOR

ATTACHMENT A
DATA SHEET E350-DS-3
BACKDRAFT DAMPERS

PROJ/BLDG : HWVP / CANISTER STORAGE BLDG.
SPEC. NO. : B-595-C-E350-15861
PREPARED BY : B. ENTEZAM B.E.
CHECKED BY : R. FLYE RF

EQUIPMENT NAME: BACKDRAFT DAMPER
EQUIPMENT NO.: BD-05I-112 & BD-05I-113

SELECTION:		PERFORMANCE :	
MANUFACTURER	*	PRESSURE DROP, IN. W.G.	SEE SPEC.
MODEL NO.	*	LEAKAGE, CFM AT DESIGN FLOW	SEE SPEC.
QUANTITY REQUIRED	2		
SIZE (WIDTH X HEIGHT), INCHES	52" X 24"		
TYPE:			
MULTIBLADE	YES		
BLADE ACTION	GRAVITY		
BLADE:			
TYPE	FLAT		
LINKED TOGETHER	YES		
PARALLEL TO SHORT/LONG SIDE	LONG		
FRAME:			
FLANGED	YES		

REMARKS:

*FURNISHED BY EQUIPMENT VENDOR

ATTACHMENT A
DATA SHEET E350-DS-4
BACKDRAFT DAMPERS

PROJ/BLDG : HWVP / CANISTER STORAGE BLDG.
SPEC. NO. : B-595-C-E350-15861
PREPARED BY : B. ENTEZAM B.E.
CHECKED BY : R. FLYE

EQUIPMENT NAME: BACKDRAFT DAMPER
EQUIPMENT NO.: BD-05J-103 THROUGH BD-05J-106

SELECTION:		PERFORMANCE :	
MANUFACTURER	*	PRESSURE DROP, IN. W.G.	SEE SPEC.
MODEL NO.	*	LEAKAGE, CFM AT DESIGN FLOW	SEE SPEC.
QUANTITY REQUIRED	4		
SIZE (WIDTH X HEIGHT), INCHES	72" X 48"	ACCESSORIES:	
TYPE:		COUNTER BALANCE	YES
MULTIBLADE	YES		
BLADE ACTION	GRAVITY		
BLADE:			
TYPE	FLAT		
LINKED TOGETHER	YES		
PARALLEL TO SHORT/LONG SIDE	LONG		
FRAME:			
FLANGE	YES		

REMARKS:

*FURNISHED BY EQUIPMENT VENDOR

ATTACHMENT A
DATA SHEET E350-DS-5
BACKDRAFT DAMPERS

PROJ/BLDG : HWVP / CANISTER STORAGE BLDG.
SPEC. NO. : B-595-C-E350-15861
PREPARED BY : B. ENTEZAM B.E.
CHECKED BY : R. FLYE RF

EQUIPMENT NAME: BACKDRAFT DAMPER
EQUIPMENT NO.: BD-05J-101 AND BD-05J-102

SELECTION:		PERFORMANCE :	
MANUFACTURER	*	PRESSURE DROP, IN. W.G.	SEE SPEC.
MODEL NO.	*	LEAKAGE, CFM AT DESIGN FLOW	SEE SPEC.
QUANTITY REQUIRED	4		
SIZE (WIDTH X HEIGHT), INCHES	36" X 36"	ACCESSORIES:	
TYPE:		COUNTER BALANCE	YES
MULTIBLADE	YES		
BLADE ACTION	GRAVITY		
BLADE:			
TYPE	FLAT		
LINKED TOGETHER	YES		
PARALLEL TO SHORT/LONG SIDE	LONG		
FRAME:			
FLANGE	YES		

REMARKS:

*FURNISHED BY EQUIPMENT VENDOR

ATTACHMENT A
DATA SHEET E350-DS-6
BACKDRAFT DAMPERS

PROJ/BLDG : HWVP / CANISTER STORAGE BLDG.
SPEC. NO. : B-595-C-E350-15861
PREPARED BY : B. ENTEZAM BE.
CHECKED BY : R. FLYE QEF

EQUIPMENT NAME: BACKDRAFT DAMPER
EQUIPMENT NO.: BD-05J-111

SELECTION:		PERFORMANCE :	
MANUFACTURER	*	PRESSURE DROP, IN. W.G.	SEE SPEC.
MODEL NO.	*	LEAKAGE, CFM AT DESIGN FLOW	SEE SPEC.
QUANTITY REQUIRED	1		
SIZE (WIDTH X HEIGHT), INCHES	24" X 24"	ACCESSORIES:	
TYPE:		COUNTER BALANCE	YES
MULTIBLADE	YES		
BLADE ACTION	GRAVITY		
BLADE:			
TYPE	FLAT		
LINKED TOGETHER	YES		
PARALLEL TO SHORT/LONG SIDE	LONG		
FRAME:			
FLANGE	YES		

REMARKS:

*FURNISHED BY EQUIPMENT VENDOR

ATTACHMENT B
FIELD INSPECTION AND CHECKOUT CHECKLIST

DAMPERS

Equipment Number _____ Purchase Order No. _____

Location _____

Installed By _____ Mfr. _____

Specification No. _____ Rev. ___ Dwg. No. _____ Rev. ___

NOTES:
1) This checklist covers the general requirements for the inspection and testing of equipment for start-up. It should be used in conjunction with the manufacturer's installation, testing and operating instructions.
2) All test equipment and instrumentation shall be properly calibrated per manufacturer's instructions. Items out of calibration or damaged shall not be used for testing.
3) Record all defects, missing parts, etc., and action taken to correct.

Items to Inspect/Check/Test	Installation Meets Requirements Signature	Recorded Data Remarks
(Inspection/check/test procedures to be detailed in this section. Items should be listed in the order to be accomplished.)		

PROCEDURE APPROVAL — SELLER REPRESENTATIVE _____ DATE _____

BUYER'S REPRESENTATIVE _____ DATE _____

TEST COMPLETION ACKNOWLEDGEMENT — SELLER REPRESENTATIVE _____ DATE _____

BUYER'S OFFICER'S REPRESENTATIVE _____ DATE _____

U.S. DEPARTMENT OF ENERGY
Hanford Waste Vitrification Plant
Richland, Washington
DOE Contract DE-AC06-86RL10838

FLUOR DANIEL, INC.
Advanced Technology Division
Fluor Contract 8457

SECTION 15870
AIR DISTRIBUTION DEVICES
B-595-C-E350-15870

APPROVED FOR CONSTRUCTION

REVISION 1 PER CR-0859
ISSUE DATE 8/4/93

WAPA YES ___ NO X
QUALITY LEVEL I ___ II X
SAFETY CLASS 1__ 2__ 3 X 4__

ORIGINATOR:

Behzad Entezam 7/8/93
B. Entezam, HVAC Engineer Date

CHECKER:

R. E. Flye 7.8.93
R. E. Flye, HVAC Engineer Date

APPROVED BY:

Manuel G. Mercado 7/14/93
M. G. Mercado Lead Discipline Engineer Date

SECTION 15870
AIR DISTRIBUTION DEVICES
B-595-C-E350-15870

TABLE OF CONTENTS

ATTACHMENTS

SECTION 15870
AIR DISTRIBUTION DEVICES

PART 1 GENERAL

1.1 SUMMARY

This section defines the minimum technical requirements for furnishing, installing, and checking air distribution devices for heating, ventilating, and air conditioning system.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AIR DIFFUSION COUNCIL (ADC)

ADC 1062 R4	1977 Certification, Rating, and Test Manual

AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND AIR-CONDITIONING ENGINEERS, INC. (ASHRAE)

ASHRAE 70	1991 Method of Testing for Rating the Performance of Outlets and Inlets

1.3 RELATED REQUIREMENTS

Specification Section 01730 Operation and Maintenance Data

1.4 DEFINITIONS

(Not Used)

1.5 SYSTEM DESCRIPTION

(Not Used)

1.6 SUBMITTALS

Submit the following in accordance with the Vendor Drawing and Data Requirements section of the Order/Subcontract. The data required shall include but not be limited to the following:

1.6.1 Literature - Provide descriptive literature and catalog sheets for each piece of equipment and/or component with manufacturer's name, model number(s), and shipping weight.

1.6.2 Dimensional Outline Drawings - The drawings shall include:

A. Plan views and assembly drawings.

B. Sectional views showing internal arrangement of components.

C. Overall dimensions and interfacing dimensions.

D. Mounting hole locations.

E. Duct connection sizes and configuration.

F. Performance Data - Performance data including tables and curves.

1.6.3 Certificate of Compliance - Certification documents in accordance with Paragraph 2.1.1 of this specification.

1.6.4 Parts List and Spare Parts List - A complete parts list and a list of manufacturer's recommended spare parts. Include sufficient information to permit procurement of parts from the manufacturer or any subsupplier. In addition, a copy of each shall be shipped with the equipment.

1.6.5 Installation, Operating, and Maintenance Instructions - Detailed installation, operating, and maintenance instructions shall be submitted in accordance with Specification Section 01730, Operation and Maintenance Data.

1.6.6 Inspection and Checkout List - The Seller shall prepare a checklist for the inspection and checkout of the Air Distribution Devices using the format of Attachment A or other form that includes all the information requested in Attachment A. This checklist shall be submitted to the Buyer and shall include the following as a minimum:

A. All devices have been installed, are fastened and are not damaged.

B. All gaskets are in place.

C. All volume control devices provided integral with the air distribution devices are properly operating.

1.6.7 Construction Acceptance Test (CAT) - Inspection and testing per Paragraph 3.3.1 of this specification.

1.7 **CLASSIFICATION OF SYSTEM AND COMPONENTS**

(Not Used)

1.8 PROJECT OR SITE ENVIRONMENTAL CONDITIONS

(Not Used)

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 General

2.1.1.1 Air distribution devices as specified shall consist of diffusers, registers and grilles. Performance rating of the diffusers, registers and grilles shall be certified by the Air Diffusion Council (ADC). Performance ratings shall include noise, airflow (CFM) capacity, and air velocity at occupancy level as indicated below. All ratings shall be based on performance tests conducted in accordance with ADC Test Code 1062 R4 and/or ASHRAE Standard 70. All air distribution devices shall be furnished in accordance with the Contract Drawings, and this specification.

2.1.1.2 The manufacturer shall verify that all air distribution device selections meet the ASHRAE noise criteria as shown below with air velocities at the occupancy level not in excess of 50 fpm for office type areas, and for the ventilated areas such as process areas and equipment rooms, the terminal velocity shall be within the range of 100 - 200 fpm.

Location	Noise Level
Offices	30 - 35
Corridor, Vestibule, Toilet	35 - 40
Mech. Equipment Room, Operating Area	40 - 45

2.1.1.3 The type, size in inches, and design airflow rate (CFM) at the diffusers, registers and grilles shall be as indicated on the Contract Drawings.

2.1.2 Description

2.1.2.1 Supply Air Registers

Supply air registers shall be provided of steel construction and shall have the following features:

A. Louvers shall be steel airfoil type and individually adjustable. Two sets of louvers shall be provided. Front set of blades shall be parallel to the short dimension and rear set parallel to the long dimension. Blade size shall be 3/4 inch wide and shall have a 3/4 inch spacing between blades.

B. Damper shall be the opposed blade type and shall be screwdriver-operable from the face.

C. Screw holes shall be countersunk and the holes shall be designed for sheet metal screws.

D. Distance between support bars shall not exceed 24 inches.

E. Registers shall be supplied with gaskets constructed to fit the register mounting flange. Gaskets shall be designed to minimize air leakage between the mounting surface and the register and shall be arranged to prevent rattling. Gaskets for registers shall be 0.25 inch thick polyurethane foam.

F. The supply air registers shall have an off-white paint of baked-on enamel finish.

Supply air registers shall be Titus Series 270, Model 272-RS5 or equal.

2.1.2.2 Return Air/Exhaust Air Registers

Return air/exhaust air registers shall be provided of steel construction and shall have the following features:

A. Blades shall be the fixed type, set for 30° deflection, and spaced at 1/2 inch centers. Blades shall be positioned parallel to the short dimension.

B. Screw holes shall be countersunk, and the holes shall be designed for sheet metal screws.

C. Damper shall be the opposed blade type and shall be screwdriver-operable from the face.

D. Registers shall be supplied with gaskets constructed to fit the register mounting flange. Gaskets shall be designed to minimize air leakage between the mounting surface and the register and shall be arranged to prevent rattling. Gaskets for registers shall be 0.25 inch thick polyurethane foam.

E. The return air/exhaust air registers shall have an off-white paint of baked-on enamel finish.

Return air/exhaust air registers shall be Titus Series 25, Model 25-RS or equal.

2.1.2.3 Ceiling Supply Air Diffusers

Ceiling supply air diffusers with 24 inches x 24 inches or 12 inches x 12 inches perforated panels shall be provided as indicated on the drawings. The diffusers shall be provided with round neck or square neck adapters for duct connections as indicated on the drawings. The ceiling supply diffusers shall be suitable for suspended acoustical ceiling system or surface ceiling mounting application as shown on drawings.

The ceiling supply air diffusers shall be provided of steel construction and shall have the following features:

A. Off-white paint of baked enamel on a perforated metal face plate. Face plate perforation pattern shall be 3/16 inch diameter holes located on 1/4 inch staggered centers adequate for a minimum 50 percent free open area.

B. Adjustable pattern control blades shall be provided and designed to control air discharge pattern from horizontal to vertical.

C. Adjustable modular core construction. Each supply air diffuser shall be capable of adjustment for any core pattern (4-way, 3-way, 2-way, 2-way corner and 1-way) in the field by rearrangement of the modular core assembly.

D. Each supply air diffuser shall have an equalizing grid and an opposed blade volume control damper which is screwdriver operable from the diffuser face.

E. The supply air diffusers for suspended acoustical ceiling system shall be lay-in type of panel size as indicated on the drawings.

F. Supply air diffusers requiring round connections shall be provided with square to round adapter.

G. Supply air diffusers shall be supplied with gaskets constructed to fit the diffuser mounting flange. Gaskets shall be designed to minimize air leakage between the mounting surface and the diffuser and shall be arranged to prevent rattling. Gaskets for the diffusers shall be 0.25 inch thick polyurethane foam.

H. The ceiling supply air diffusers shall have an off-white paint of baked-on enamel finish.

The supply air diffusers shall be Titus Model PMC, or equal.

2.1.2.4 Supply Air Diffusers

Supply air diffusers shall be provided to be used for non ceiling application. Air diffusers shall be provided of steel construction and shall have the following features:

A. Each supply air diffusers shall have removable core at the face of the diffuser.

B. Each supply air diffuser shall have an equalizing grid and an opposed blade volume control damper which is screwdriver operable from the diffuser face.

C. Diffusers shall be supplied with gaskets constructed to fit the diffuser mounting flange. Gaskets shall be designed to minimize air leakage between the mounting surface and the diffuser and shall be arranged to prevent rattling. Gaskets for the diffusers shall be 0.25 inch thick polyurethane foam.

D. The supply air diffusers shall have an off-white paint of baked enamel finish.

The supply air diffusers shall be Titus, Model TDC-1, or equal, with round or rectangular adapter, as indicated on the drawings for duct connections.

2.1.2.5 Ceiling Return Air/Exhaust Air Registers

Ceiling return air/exhaust air with 24 inches x 24 inches or 24 inches x 12 inches perforated panels and volume control dampers shall be provided as indicated on the drawings. The register shall be provided with round neck or rectangular adapters for duct connections. The return air/exhaust air diffusers shall be suitable for suspended acoustical ceiling system or surface ceiling mounting application as shown on drawings.

Ceiling return air/exhaust air registers shall be provided of steel construction and shall have the following features:

A. Off-white baked enamel perforated metal face plate. Face plate perforation pattern shall be 3/16 inch diameter holes located on 1/4 inch staggered centers adequate for a minimum 50 percent free open area.

B. Each return air/exhaust air register shall have an opposed blade type damper which shall be screwdriver operable from the register face.

C. The return air/exhaust air register for suspended acoustical ceiling system shall be lay-in type of size as indicated on the drawings.

D. Ceiling return air/exhaust air registers shall be supplied with gaskets constructed to fit the diffuser mounting flange. Gaskets shall be designed to minimize air leakage between the mounting surface and the diffuser and shall be arranged to prevent rattling. Gaskets for the diffusers shall be 0.25 inch thick polyurethane foam.

E. The return air/exhaust air diffusers shall have an off-white paint of baked enamel finish.

The exhaust air/return air registers shall be Titus, Model PXP or equal.

2.2 FABRICATION AND MANUFACTURE

(Not Used)

2.3 LABELING

In addition to the manufacturer's identification nameplate, each unit shall be supplied with a corrosion-resistant metal tag identification in accordance with Specification Section 15196, Paragraph 2.2.2.9.

2.4 PACKAGING

Preparation for shipment and packing shall conform to the manufacturer's standards and shall provide protection against corrosion and damage from normal handling. Preparation shall include the following:

2.4.1 Machined surfaces and threads shall be protected during shipment by application of grease or other suitable rust inhibiting compound.

2.4.2 Temporary bracing, supports, and rigging connections shall be provided, as necessary, to prevent damage during shipment, lifting, and unloading.

2.4.3 Separate or loose parts shall be completely boxed and attached to the main device and shipped as a unit. All shipping boxes shall be identified with the equipment number(s), Seller's name, project identification, and destination with ink, paint, or other indelible material. A copy of the packing list shall be securely affixed to the outside of each package or crate.

PART 3 EXECUTION

3.1 PREPARATION

Before installation, Seller shall review all pertinent documentation and verify the following:

3.1.1 All documentation (data and drawings) required by Paragraph 1.6 of this specification has been submitted to the Buyer.

3.1.2 The Seller has received from the Buyer approved specifications and Contract Drawings covering all air distribution devices to be installed.

3.1.3 Inspect each air distribution devices to make sure that it is complete with all accessories as specified, and no damage has occurred.

3.1.4 Inspect the location on which the air distribution device will be installed.

3.1.5 Verify that the components carry the required certifications in accordance with Paragraph 2.1 of this specification.

3.2 INSTALLATION, APPLICATION AND ERECTION

3.2.1 Air distribution devices shall be installed in accordance with manufacturer's instructions and as shown on the Contract Drawings. Fastening shall be by use of sheet metal screws. Gaskets shall be installed between the devices and the mounting surfaces.

3.2.2 The Seller shall provide touch up coating on air distribution device(s) and accessories to match manufacturer's factory coating where it has been damaged.

3.2.3 Air distribution devices for inverted tee bar ceilings application shall be positively attached to the ceiling suspension main runners or to cross runners with the same carrying capacity.

3.3 FIELD QUALITY CONTROL

3.3.1 Inspection and testing shall be performed as required by field inspection and checkout checklist (Attachment A).

3.4 ADJUSTMENTS

(Not Used)

3.5 CLEANING

(Not Used)

3.6 **PROTECTION**

(Not Used)

3.7 **DEMONSTRATION**

(Not Used)

3.8 **SCHEDULES**

(Not Used)

END OF SECTION

ATTACHMENT A
FIELD INSPECTION AND CHECKOUT CHECKLIST

AIR DISTRIBUTION DEVICES

Equipment Number _____ Purchase Order No. _____

Location _____

Installed By _____ Mfr. _____

Specification No. _____ Rev. ___ Dwg. No. _____ Rev. ___

NOTES:
1) This checklist covers the general requirements for the inspection and testing of equipment for start-up. It should be used in conjunction with the manufacturer's installation, testing and operating instructions.
2) All test equipment and instrumentation shall be properly calibrated per manufacturer's instructions. Items out of calibration or damaged shall not be used for testing.
3) Record all defects, missing parts, etc., and action taken to correct.

Items to Inspect/Check/Test	Installation Meets Requirements Signature	Recorded Data Remarks
(Inspection/check/test procedures to be		
detailed in this section. Items should be		
listed in the order to be accomplished.)		

PROCEDURE APPROVAL — SELLER REPRESENTATIVE _____ DATE _____

PROCEDURE APPROVAL — BUYER'S REPRESENTATIVE _____ DATE _____

TEST COMPLETION ACKNOWLEDGEMENT — SELLER REPRESENTATIVE _____ DATE _____

TEST COMPLETION ACKNOWLEDGEMENT — BUYER'S REPRESENTATIVE _____ DATE _____

U.S. DEPARTMENT OF ENERGY
Hanford Waste Vitrification Plant
Richland, Washington
DOE Contract DE-AC06-86RL10838

FLUOR DANIEL, INC.
Advanced Technology Division
Fluor Contract 8457

SECTION 15878
AIR INTAKE HOODS
B-595-C-E350-15878

APPROVED FOR CONSTRUCTION

REVISION 1 PER CR-0859
ISSUE DATE 6/4/93

WAPA YES ___ NO X
QUALITY LEVEL I ___ II X
SAFETY CLASS 1__ 2__ 3 X 4__

ORIGINATOR:

Behzad Entezam 7/8/93
B. Entezam, HVAC Engineer Date

CHECKER:

R. E. Flye 7.8.93
R. E. Flye, HVAC Engineer Date

APPROVED BY:

Manuel G. Mercado 7/14/93
M. G. Mercado Lead Discipline Engineer Date

SECTION 15878
AIR INTAKE HOODS
B-595-C-E350-15878

TABLE OF CONTENTS

ATTACHMENTS

SECTION 15878
AIR INTAKE HOODS

PART 1 GENERAL

1.1 SUMMARY

This section defines the minimum technical requirements for furnishing, installing, checking and testing air intake hoods for heating, ventilating, and air conditioning system.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-88	1988 Minimum Design Loads for Buildings and Other Structures (Formerly ANSI A58.1)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	1989 Standard for the Installation of Air Conditioning and Ventilating System

1.3 RELATED REQUIREMENTS

Specification Section 01730	Operation and Maintenance Data
Specification Section 15196	Identification and Tagging Method for Mechanical Equipment

1.4 DEFINITIONS

(Not Used)

1.5 SYSTEM DESCRIPTION

(Not Used)

1.6 SUBMITTALS

Submit the following in accordance with the Vendor Drawing and Data Requirements section of the Order/Subcontract.

1.6.1 Literature - Provide descriptive literature and catalog sheets for each piece of equipment and/or component with manufacturer's name, model number(s), shipping weight and operating weight.

1.6.2 Dimensional Outline Drawings - The drawings shall include:

A. Plan views and assembly drawings, including lift points.

B. Sectional views showing internal arrangement of all components.

C. Overall dimensions and interfacing dimensions.

D. Mounting holes location and sizes.

1.6.3 Calculations - Design calculations and data in accordance with Paragraph 2.1.2 of this specification.

1.6.4 Factory Acceptance Test (FAT) - Test report in accordance with Paragraph 2.1.5 of this specification.

1.6.5 Parts List and Spare Parts List - A complete parts list and a list of manufacturer's recommended spare parts. Include sufficient information to permit procurement of parts from the manufacturer or any subsupplier.

1.6.6 Installation, Operating, and Maintenance Instructions - Detailed installation, operating, and maintenance instructions shall be submitted in accordance with Specification Section 01730, Operation and Maintenance Data.

1.6.7 Inspection and Checkout List

The Seller shall prepare a checklist for the inspection and checkout of the air intake hoods using the format of Attachment B or other form that includes all the information requested in Attachment B. This checklist shall be submitted to the Buyer and shall include the following as a minimum:

A. Air intake hoods are installed in accordance with the manufacturer's recommendations, the Contract Drawings, and this specification.

B. Air intake hoods have been leveled, aligned and securely anchored.

C. Check that air intake hoods assemblies are undamaged, clean and free of foreign materials.

D. Air intake hoods have been properly labeled.

1.6.8 Construction Acceptance Test (CAT) - Inspection and testing per Paragraph 3.3.1 of this specification.

1.7 CLASSIFICATION OF SYSTEM AND COMPONENTS

(Not Used)

1.8 PROJECT OR SITE ENVIRONMENTAL CONDITIONS

1.8.1 Climatic and Geographic Site Conditions

A. Site Elevation 714 feet above sea level

B. Barometric Pressure 14.3 psia

C. Outside Design Temperature

1) Summer Design Temperature 101°F

2) Winter Design Temperature 9°F

3) Wet Bulb Design Temperature 68°F

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Provide factory assembled, packaged, gravity intake hoods of weather proof construction, suitable for roof mounting installation as shown on the drawings. Air intake hoods shall be provided with 5/8 x 5/8 inch x 0.041 inch thick galvanized steel mesh screen with minimum air restriction.

2.1.2 Air intake hood housing shall be of 24 gauge (minimum) galvanized steel construction with hinged door designed providing access to ductwork. The hoods interior shall be reinforced with structural supports for rigidity and strength to withstand snow load of no less than 20 pounds per square feet and wind load of 70 miles per hour in accordance with ASCE 7-88, Section 7 and Section 6 respectively. Design calculations and data used shall be provided and shall be submitted to Buyer for review and approval.

Intake hood housing panels shall be of rib-lock design or welded construction. Air intake hoods base shall be constructed of 18 gauge (minimum) galvanized steel. A grey prime coat shall be applied to the entire exterior of the hoods, followed by a factory standard baked-on enamel finish.

2.1.3 Air intake hood housing shall include provision for fastening to the supporting curbs or duct flanges as shown on drawings with minimum 3/16 inch diameter self threading screws, on a maximum spacing of not more than 12 inches on centers.

2.1.4 Performance and capacities of the air intake hoods shall be as indicated on the attached data sheets.

2.1.5 Factory Acceptance Test

2.1.5.1 Each air intake hood shall be tested in the factory prior to shipment, to assure that the specified hood performances and data indicated on the data sheets are satisfied.

2.1.5.2 Test procedures shall be documented, and shall be included in the submittal of the test results as indicated below.

2.1.5.3 Test records shall contain the following information as a minimum:

1) Unit tested.
2) Date of test.
3) Equipment, instrumentation and data recorder used.
4) Type of observation.
5) Results and acceptability.
6) Action taken in connection with any deviations noted, if any.
7) Name(s) and title of person(s) evaluating test results.

2.1.5.4 Test results shall be evaluated by a responsible authority (Seller) to assure that test requirements are satisfied. Test results shall be submitted to the Buyer for review and approval.

2.2 **FABRICATION AND MANUFACTURE**

(Not Used)

2.3 **LABELING**

In addition to the manufacturer's identification plate, each air intake hood shall be supplied with a corrosion-resistant metal tag identification in accordance with Specification Section 15196, Paragraph 2.2.2.9.

2.4 **PACKAGING**

Preparation for shipment and packing shall conform to the manufacturer's standards and shall provide protection against corrosion and damage from normal handling. Preparation shall include the following:

2.4.1 Machined surfaces and threads shall be protected during shipment by application of grease or other suitable rust inhibiting compound.

2.4.2 Opening shall be suitably protected to prevent damage during shipment and shall be plugged or capped.

2.4.3 Temporary bracing, supports, and rigging connections shall be provided as necessary to prevent damage during shipment, lifting, and unloading.

2.4.4 Separate or loose parts shall be completely boxed and attached to the main equipment and shipped as a unit. All shipping boxes shall be identified with the equipment number(s), Seller's purchase order number, description of the equipment, manufacturer's name, Seller's name, project identification, and destination with ink, paint, or other indelible material. A copy of the packing list shall be securely affixed to the outside of each package or crate.

PART 3 EXECUTION

3.1 PREPARATION

Before installation, Seller shall review all pertinent documentation and verify the following:

3.1.1 All documentation (data and drawings) required by Paragraph 1.6 of this specification has been submitted to the Buyer.

3.1.2 The Seller has received from the Buyer approved specifications and Contract Drawings covering all equipment to be installed.

3.1.3 Inspect each air intake hood to make sure that it is complete with all accessories.

3.1.4 Inspect the structure mounting base (roof curb) by which the air intake hood will be supported to make sure it is of the size and location required.

3.1.5 Air intake hoods are properly labeled.

3.2 INSTALLATION, APPLICATION AND ERECTION

3.2.1 Install each air intake hood in accordance with the manufacturer's instructions, Contract Drawings and the requirements of this specification, and shall conform to NFPA 90A.

3.2.2 Fasten hoods bases to the supporting curbs or duct flanges as shown on Contract Drawings.

3.3 FIELD QUALITY CONTROL

3.3.1 Inspection and testing shall be performed as required by field inspection and checkout checklist (Attachment B).

3.4 **ADJUSTMENTS**

(Not Used)

3.5 **CLEANING**

(Not Used)

3.6 **PROTECTION**

(Not Used)

3.7 **DEMONSTRATION**

(Not Used)

3.8 **SCHEDULES**

(Not Used)

END OF SECTION

ATTACHMENT A
DATA SHEET E350-DS-1
AIR INTAKE HOODS

PROJ/BLDG : HWVP / CANISTER STORAGE BLDG.
SPEC. NO. : B-595-C-E350-15878
PREPARED BY : B. ENTEZAM BE
CHECKED BY : R. FLYE RF

EQUIPMENT NAME: AH-05I-111 AIR INTAKE HOOD
EQUIPMENT NO.: AI-05I-111

SELECTION:			
MANUFACTURER	*		
MODEL NO.	*		
QUANTITY REQUIRED	1		
PERFORMANCE:			
AIR FLOW, SCFM (min.)	1900		
STATIC PRESSURE DROP, IN W.G.	0.25		
PHYSICAL DATA:			
THROAT SIZE, INCHES	12 X 24		
INTAKE VELOCITY, FPM	475		
CURB CAP, INCHES	20 X 32		
HEIGHT, INCHES	14		
OVERALL O.D., INCHES (L, W, H)	26 X 36 X 14		
CONSTRUCTION:	SEE SPECIFICATION		
ACCESSORIES:			
BIRD SCREEN	YES		
DAMPERS	NO		
ROOF CURB	NO		
FINISH	SEE SPECIFICATION		
UNIT WT., LBS.	*		

REMARKS:

*FURNISHED BY EQUIPMENT VENDOR

ATTACHMENT A
DATA SHEET E350-DS-2
AIR INTAKE HOODS

PROJ/BLDG : HWVP / CANISTER STORAGE BLDG.
SPEC. NO. : B-595-C-E350-15878
PREPARED BY : B. ENTEZAM B.E.
CHECKED BY : R. FLYE GES

EQUIPMENT NAME: AH-05I-112 & 113 AIR INTAKE HOOD
EQUIPMENT NO.: AI-O5I-112 & AI-O5I-113

SELECTION:			
MANUFACTURER	*		
MODEL NO.	*		
QUANTITY REQUIRED	2		
PERFORMANCE:			
AIR FLOW, SCFM (min.)	12000		
STATIC PRESSURE DROP, IN W.G.	0.25		
PHYSICAL DATA:			
THROAT SIZE, INCHES	24 X 66		
INTAKE VELOCITY, FPM	475		
CURB CAP, INCHES	32 X 74		
HEIGHT, INCHES	19		
OVERALL O.D., INCHES (L, W, H)	53 X 96 X 19		
CONSTRUCTION:	SEE SPECIFICATION		
ACCESSORIES:			
BIRD SCREEN	YES		
DAMPERS	NO		
ROOF CURB	NO		
FINISH	SEE SPECIFICATION		
UNIT WT., LBS.	*		

REMARKS:

*FURNISHED BY EQUIPMENT VENDOR

ATTACHMENT B
FIELD INSPECTION AND CHECKOUT CHECKLIST

AIR INTAKE HOODS

Equipment Number _____ Purchase Order No. _____

Location _____

Installed By _____ Mfr. _____

Specification No. _____ Rev. _____ Dwg. No. _____ Rev. _____

NOTES: 1) This checklist covers the general requirements for the inspection and testing of equipment for start-up. It should be used in conjunction with the manufacturer's installation, testing and operating instructions.
2) All test equipment and instrumentation shall be properly calibrated per manufacturer's instructions. Items out of calibration or damaged shall not be used for testing.
3) Record all defects, missing parts, etc., and action taken to correct.

Items to Inspect/Check/Test	Installation Meets Requirements Signature	Recorded Data Remarks
(Inspection/check/test procedures to be detailed in this section. Items should be listed in the order to be accomplished.)		

PROCEDURE APPROVAL — SELLER REPRESENTATIVE _____ DATE _____

BUYER'S REPRESENTATIVE _____ DATE _____

TEST COMPLETION ACKNOWLEDGEMENT — SELLER REPRESENTATIVE _____ DATE _____

BUYER'S REPRESENTATIVE _____ DATE _____

U.S. DEPARTMENT OF ENERGY
Hanford Waste Vitrification Plant
Richland, Washington
DOE Contract DE-AC06-86RL10838

FLUOR DANIEL, INC.
Advanced Technology Division
Fluor Contract 8457

SECTION 15883
AIR FILTERS (HVAC)
B-595-C-E350-15883

APPROVED FOR CONSTRUCTION

REVISION 1 PER CR-0859
ISSUE DATE 8/4/93

WAPA YES ___ NO X
QUALITY LEVEL I ___ II X
SAFETY CLASS 1__ 2__ 3 X 4__

ORIGINATOR:

Behzad Entezam 7/8/93
B. Entezam, HVAC Engineer Date

CHECKER:

R. E. Flye 7.8.93
R. E. Flye, HVAC Engineer Date

APPROVED BY:

Manuel G. Mercado 7/14/93
M. G. Mercado Lead Discipline Engineer Date

SECTION 15883
AIR FILTERS (HVAC)
B-595-C-E350-15883

TABLE OF CONTENTS

ATTACHMENTS

SECTION 15883
AIR FILTERS (HVAC)

PART 1 GENERAL

1.1 SUMMARY

This section defines the minimum technical requirements for furnishing, testing, and installing Air Filters Type I, Type II, and Type IIA for heating, ventilating and air conditioning system.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 850	1984 Standard for Commercial and Industrial Air Filter Equipment

AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND AIR-CONDITIONING ENGINEERS, INC. (ASHRAE)

ASHRAE 52	1976 ASHRAE Method of Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter

UNDERWRITERS LABORATORIES, INC. (UL)

UL 900	1987 Safety Standard for Air Filter Units

1.3 RELATED REQUIREMENTS

Specification Section 01730 Operation and Maintenance Data

1.4 DEFINITIONS

(Not Used)

1.5 SYSTEM DESCRIPTION

(Not Used)

1.6 SUBMITTALS

Submit the following in accordance with the Vendor Drawing and Data Requirements section of the Order/Subcontract.

1.6.1 Literature - Provide descriptive literature and catalog sheets for each filter type and/or component with manufacturer's name, model number(s), and shipping weight.

1.6.2 Dimensional Outline Drawings - The drawings shall include:

A. Plan views and assembly drawings.

B. Sectional views.

C. Overall dimensions and interfacing dimensions.

D. Mounting requirements.

1.6.3 Factory Acceptance Test (FAT) - Certification documents and data in accordance with Paragraph 2.1.4 of this specification.

1.6.4 UL Certification - Provide certifiation ina ccordance with Paragraph 2.1.1.2 of this specification.

1.6.5 Parts List and Spare Parts List - A complete parts list and a list of manufacturer's recommended spare parts. Include sufficient information to permit procurement of parts from the manufacturer or any subsupplier.

1.6.6 Installation, Operating, and Maintenance Instructions - Detailed installation, operating, and maintenance instructions shall be submitted in accordance with Specification Section 01730, Operation and Maintenance Data.

1.6.7 Inspection and Checkout List - The Seller shall prepare a checklist for the inspection and checkout of the air filters using the format of Attachment A or other form that includes all the information requested in Attachment A. This checklist shall be submitted to the Buyer and shall include the following as a minimum:

A. Air filters installed in accordance with the manufacturer's recommendations, the drawings, and this specification.

B. Filter mounting frames have been leveled, aligned and securely anchored.

C. Air filters are clean, undamaged and free of foreign material.

D. Gaskets are installed where required.

E. Air filters rest squarely and securely in their holding frame.

F. Filters can slide in and out without interference due to obstructions.

G. Filter media and retainers are securely fastened to the frame.

H. There are no visible gaps between the media and the frame.

1.6.8 Construction Acceptance Test (CAT) - Inspection and testing per Paragraph 3.3.1 of this specification.

1.7 **CLASSIFICATION OF SYSTEM AND COMPONENTS**

(Not Used)

1.8 **PROJECT OR SITE ENVIRONMENTAL CONDITIONS**

(Not Used)

PART 2 PRODUCTS

2.1 **MATERIALS AND EQUIPMENT**

2.1.1 General

2.1.1.1 The quantity, type, performance and capacity of the filters shall be as indicated on the drawings.

2.1.1.2 Air filters shall be constructed of noncombustible materials meeting the requirements for UL 900, Class 1. Filters shall comply with ARI 850.

2.1.2 Type I Air Filters

Type I air filters shall be nominal 24 inches square by nominal 2 inches thick (unless otherwise indicated on the equipment specification data sheets) pleated disposable type Farr 30/30 as manufactured by Farr Co. or equal. The filter shall consist of a nonwoven cotton fabric media, media support grid and enclosing frame.

2.1.2.1 Filter Media

The effective filter media shall be not less than 4.5 square feet of media per 1.0 square foot of filter face area and shall not contain less than 11 pleats per linear foot.

2.1.2.2 Media Support Grid

The media support shall be a welded wire grid with an effective open area of not less than 96 percent of the surface area. The welded wire grid shall be adequately bonded to the filter media to eliminate media oscillation and media pull away. The media support grid shall be formed in such a manner that it effects a radial pleat design, allowing total use of free area.

2.1.2.3 Enclosing Frame

The enclosing frame shall be constructed of a rigid, heavy duty type chipboard with diagonal support members bonded to the air entering and air exit side of each pleat, to ensure pleat stability. The inside periphery of the enclosing frame shall be bonded to the filter pack sufficient to eliminate air bypass.

2.1.2.4 Holding Frame

Holding frames shall be designed to accept the filter assembly. Holding frames shall be constructed of 16 gauge galvanized steel, with 3/4 inch filter-sealing flange. A polyurethane foam gasket shall be attached to the sealing flange. The holding frame shall have fasteners to hold filter assembly in place. Holding frame shall be Farr Type 8.

2.1.3 Type II and IIA Air Filters

Type II and IIA air filters shall be nominal 24 inches square by nominal 12 inches deep disposable type, Varicel model as manufactured by American Air Filter Company or equal. Each air filter shall consist of a factory assembled filter element incorporating a fine-fibered all-glass medium, crimped aluminum separators, galvanized steel frame with a 1/2 inch gasket flange on the air inlet face.

2.1.3.1 Filter Media

The filter media shall be constructed so that the individual pleats are maintained in a tapered form by the internal separators under rated air flow conditions. At any point, the sizes of the upstream and downstream air passages shall be in exact proportion to the volume of filtered and unfiltered air being handled at that point. There shall be at least 40 supports per square foot of pleat area. The pleat shall be sealed with thermoplastic. The percentage of open area of the full size cartridge face shall not be less than 72 percent of the total face area.

2.1.3.2 Filter Housing

As indicated on the drawings, the Type II and IIA air filters shall be supplied with a completely factory-assembled filter housing. The housing shall be constructed of 16 gauge galvanized steel with 4-inch turned in flanges on both the air entering and air leaving side to provide a flush exterior and to facilitate connections to adjacent duct flanges. The housing shall be furnished with a side entry access door for filter servicing. The access door shall be provided with a closed-cell neoprene rubber gasket applied directly at the door perimeter face. The access door shall be equipped with a quick acting spring loaded door latch constructed of non-corrosive material. The location of the access door shall be as indicated on the drawings with a side servicing clearance of 30 inches minimum.

2.1.4 Factory Acceptance Test

The Seller shall provide a certificate of compliance that the filters meet the performance requirements indicated herein when tested in accordance with ASHRAE Standard 52-76 as indicated below:

2.1.4.1 Type I Filters

Type I filters when tested in accordance with ASHRAE Standard 52-76 shall have the following characteristics at 2000 SCFM:

A. Initial resistance shall not exceed 0.30 inch w.g. at 500 feet per minute approach velocity.

B. Average atmospheric dust spot efficiency, 25-30 percent with final filter resistance up to 1.00 inch w.g. as measured by Dust Spot Test Method per ASHRAE Standard 52.

C. Average synthetic dust weight arrestance shall be not less than 94 percent with final filter resistance up to 1.00 inch w.g.

2.1.4.2 Type II Filters

Type II filters when tested in accordance with ASHRAE Standard 52-76 shall have the following characteristics at 2000 SCFM:

A. Initial resistance shall not exceed 0.50 inch w.g. at 500 feet per minute approach velocity.

B. Average atmospheric dust spot efficiency, 60-65 percent by the Dust Spot Test Method per ASHRAE Standard 52.

C. Minimum 220 grams dust holding capacity at 1.0 inch w.g. final resistance.

2.1.4.3 Type IIA Filters

Type IIA filters when tested in accordance with ASHRAE Standard 52-76 shall have the following characteristics at 2000 SCFM:

A. Initial resistance shall not exceed 0.65 inch w.g. at 500 feet per minute approach velocity.

B. Average atmospheric dust spot efficiency, 90-95 percent by the Dust Spot Test Method per ASHRAE Standard 52.

C. Minimum 220 grams dust holding capacity at 1.2 inch w.g. final resistance.

2.2 FABRICATION AND MANUFACTURE

(Not Used)

2.3 LABELING

In addition to the manufacturer's identification nameplate, each filter unit shall be supplied with a corrosion-resistant metal tag identification in accordance with Specification Section 15196, Paragraph 2.2.2.9.

2.4 PACKAGING

Preparation for shipment and packing shall conform to the manufacturer's standards and shall provide protection against corrosion and damage from normal handling and storage. Preparation shall include the following:

2.4.1 Sufficient packing material shall be provided in shipping cartons to prevent damage during shipment, lifting, and unloading.

2.4.2 Separate or loose parts shall be completely boxed and attached to the main equipment and shipped as a unit. All shipping boxes shall be identified by the Contractor's purchase order number, description of the equipment, manufacturer's name, Contractor's name, project identification, and destination with ink, paint, or other indelible material. A copy of the packing list shall be securely affixed to the outside of each package or crate.

PART 3 EXECUTION

3.1 PREPARATION

Before installation, Seller shall review all pertinent documentation and verify the following:

3.1.1 All documentation (data and drawings) required by Paragraph 1.6 of this specification has been submitted to the Buyer.

3.1.2 The Seller has received from the Buyer approved specifications and Contract Drawings covering all filter units to be installed.

3.1.3 Inspect each filter to make sure that there is no visible evidence of pin holes or other penetrations of the filter media and that it is of the type specified.

3.1.4 Inspect each filter frame to make sure that the filter openings are of the proper size and that gaskets are in place.

3.1.5 Verify that the filter unit carries the required certifications per Paragraph 2.1 of this specification.

3.2 INSTALLATION, APPLICATION AND ERECTION

3.2.1 Filter assemblies shall be installed in accordance with manufacturer's instructions and as shown on Contract Drawings.

3.3 FIELD QUALITY CONTROL

3.3.1 Inspection and testing shall be performed as required by field inspection and checkout checklist (Attachment A).

3.4 ADJUSTMENTS

(Not Used)

3.5 CLEANING

(Not Used)

3.6 PROTECTION

(Not Used)

3.7 DEMONSTRATION

(Not Used)

3.8 SCHEDULES

(Not Used)

END OF SECTION

ATTACHMENT A
FIELD INSPECTION AND CHECKOUT CHECKLIST

AIR FILTERS (HVAC)

Equipment Number _____ Purchase Order No. _____

Location _____

Installed By _____ Mfr. _____

Specification No. _____ Rev. ___ Dwg. No. _____ Rev. ___

NOTES: 1) This checklist covers the general requirements for the inspection and testing of equipment for start-up. It should be used in conjunction with the manufacturer's installation, testing and operating instructions.
2) All test equipment and instrumentation shall be properly calibrated per manufacturer's instructions. Items out of calibration or damaged shall not be used for testing.
3) Record all defects, missing parts, etc., and action taken to correct.

Items to Inspect/Check/Test	Installation Meets Requirements Signature	Recorded Data Remarks
(Inspection/check/test procedures to be detailed in this section. Items should be listed in the order to be accomplished.)		

PROCEDURE APPROVAL — SELLER REPRESENTATIVE _____ DATE _____

PROCEDURE APPROVAL — BUYER'S REPRESENTATIVE _____ DATE _____

TEST COMPLETION ACKNOWLEDGEMENT — SELLER REPRESENTATIVE _____ DATE _____

TEST COMPLETION ACKNOWLEDGEMENT — BUYER'S REPRESENTATIVE _____ DATE _____

U.S. DEPARTMENT OF ENERGY
Hanford Waste Vitrification Plant
Richland, Washington
DOE Contract DE-AC06-86RL10838

FLUOR DANIEL, INC.
Advanced Technology Division
Fluor Contract 8457

SECTION 15990
HVAC SYSTEM TESTING AND BALANCING
B-595-C-E350-15990

APPROVED FOR CONSTRUCTION

REVISION 1 PER CR-0859
ISSUE DATE 7/14/93

WAPA YES ___ NO X
QUALITY LEVEL I ___ II X
SAFETY CLASS 1__ 2__ 3 X 4__

ORIGINATOR:

Behzad Entezam 7/8/93
B. Entezam, HVAC Engineer Date

CHECKER:

R. E. Flye 7.8.93
R. E. Flye, HVAC Engineer Date

APPROVED BY:

Manuel G. Mercado
M. G. Mercado Lead Discipline Engineer

7/14/93
Date

SECTION 15990
HVAC SYSTEM TESTING AND BALANCING
B-595-C-E350-15990

TABLE OF CONTENTS

ATTACHMENTS

SECTION 15990
HVAC SYSTEM TESTING AND BALANCING

PART 1 GENERAL

1.1 SUMMARY

1.1.1 This section defines the minimum technical requirements for testing and balancing of air and refrigerant system for heating, ventilating and air conditioning system for the Canister Storage Building.

1.1.2 The Seller shall obtain the services of an independent test and balance agency that specializes in, and whose business is limited to, the testing and balancing of HVAC systems, to perform the testing, adjusting, and balancing work specified herein, in conjunction/coordination with control system contractor. The agency selected must be approved by the Buyer and must meet the following minimum requirements:

1) Be fully certified by the Associated Air Balance Council (AABC).

2) Have successfully completed jobs of a similar scope and nature as that specified herein.

3) Employ an AABC Certified Test and Balance Engineering who shall direct the work and sign and seal the final test and balance report.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASSOCIATED AIR BALANCE COUNCIL (AABC)

AABC Manual	1979 National Standards for Field Measurements and Instrument
AABC	1989 Volume A National Standard for Testing and Balancing HVAC Systems

1.3 RELATED REQUIREMENTS

(Not Used)

1.4 **DEFINITIONS**

(Not Used)

1.5 **SYSTEM DESCRIPTION**

(Not Used)

1.6 **SUBMITTALS**

Submit the following in accordance with the Vendor Drawing and Data Requirements section of the Order/Subcontract.

1.6.1 Qualification of the certified Testing and Balancing Engineer (TBE) assigned to this job, including his TBE Certification Number, a description of previous jobs of similar scope and nature, the extent and capacity of participation.

1.6.2 Airflow diagrams for each system showing all outlets, branches, automatic and manual balancing dampers, coils, fans and capacities, nonducted air flows and proposed pitot traverse points. Outlets and pitot traverse points, with design capacities indicated, will be numbered for cross reference to submittal data. All duct instrument taps shall be constructed in accordance with the Contract Drawings.

1.6.3 Detailed testing and balancing procedures, in accordance with the AABC Manual, including data sheets to be used.

1.6.4 Fabrication Acceptance Test (FAT) - Testing and balancing report in accordance with Paragraph 3.1.4 of this specification.

1.6.5 A list of instrumentation to be used including type, make and model, range and calibration test report, date of calibration sheets for each type of instrument with National Bureau of Standards traceability.

1.6.6 Inspection and Checkout List - The Seller shall prepare a checklist for the inspection and checkout of the HVAC Systems using the format of Attachment A or other form that includes all the information requested in Attachment A. This checklist shall be submitted to the Buyer and shall include the following as a minimum:

A. Equipment, ducts, and air intakes are clean, undamaged, and free of foreign material.

B. Bearings are aligned and have been lubricated in accordance with the manufacturer's recommendation.

C. Rotating equipment has been checked for freedom of rotation.

D. Belt drive systems are aligned and have proper belt tension.

E. Drive couplings are aligned and have the proper clearance.

F. Belt and coupling guards are in place.

G. Fans, pumps and motors have been checked for vibration.

H. Dampers have been fully stroked and they all have freedom of motion and travel.

I. Damper and operator linkage is properly connected and adjusted.

J. Refrigerant system is filled in accordance with manufacturer recommended charge pressures and is retaining refrigerant.

K. All instruments are installed in accordance with the Contract Drawings and the specifications.

L. All operating controls and interlocks have been cycled and have been found to be functioning properly.

M. Equipment, ductwork, instrumentation and piping have been properly labeled.

N. Filters have been checked to verify correct filter size and type have been installed.

1.6.7 Construction Acceptance Test (CAT) - Inspection and testing per Paragraph 3.3.1 of this specification.

1.7 **CLASSIFICATION OF SYSTEM AND COMPONENTS**

(Not Used)

1.8 **PROJECT OR SITE ENVIRONMENTAL CONDITIONS**

1.8.1 Climatic and Geographic Site Conditions

A. Site Elevation 714 feet above sea level

B. Barometric Pressure 14.3 psia

C. Outside Design Temperature

1) Summer Design Temperature 101°F

2) Winter Design Temperature 9°F

3) Wet Bulb Design Temperature 68°F

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 General

The Seller shall provide all labor, supervision, supplies, test instruments, calibration standards, materials, tools, ladders, scaffolding, extension cords and equipment as required for testing, and balancing of all HVAC systems and equipment. HVAC systems and equipment include but are not limited to, air handling units, air intake hoods, condensing units, fans, drive motors, coils, dampers, ductwork and valves. All electric power required to carry out the provisions of this specification will be provided to the Seller. The Seller, however, shall provide such temporary wiring as required.

2.1.2 Test Instruments

A. All test instruments and gauges shall, as a minimum, be in accordance with AABC requirements as specified in the AABC Manual.

B. All test instruments and gauges shall have been calibrated prior to beginning balancing work and shall be recalibrated periodically in accordance with the instrument manufacturer's recommendations. In addition, if any test instrument is found to be out of calibration, it shall be recalibrated prior to any further use and systems balanced with the subject instrument shall be rebalanced at the discretion of the Buyer. Calibration shall be performed by an independent calibration laboratory with National Bureau of Standards traceability. Copies of test instrument calibration data sheets for each test instrument shall be kept on file at the jobsite by the Seller and also submitted to the Buyer as the part of Testing and Balancing System Reports in accordance with Paragraph 3.1.4 of this specification.

2.2 FABRICATION AND MANUFACTURE

(Not Used)

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 General

A. Before beginning of testing and balancing work, the field inspection and checkout of system installation and system construction start-up test shall be completed, and the systems including instrumentation and controls shall have been operated for a minimum of 24 hours continuously and without incident.

B. An authorization to proceed has been given by the Buyer.

3.1.2 System Testing and Balancing

All systems shall be tested and balanced for required flow in accordance with the applicable methods and procedures set forth in the AABC standards referenced hereto. The test and balance procedures for each individual piece of equipment or system shall be as instructed in the AABC Manual and as indicated below.

A. All systems shall be balanced to design parameters indicated on the Contract Drawings and specification.

B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops, or limit set points. Adjust and set backdraft dampers counterweight balance.

C. Where it is required that measurements or comparisons be made to the outside static pressure, such measurement or comparison shall be made from the remote source via the installed atmospheric reference header as shown on the Contract Drawings.

D. In the event that system balance cannot be achieved, and additional sheaves, belts, dampers and/or other balancing devices are required to obtain the required system balance, or if any instrument or control problems exist, the Buyer shall be notified in writing.

3.1.3 Upon completion of testing, adjusting and balancing work, the system shall be operated for 48 hours continuously and maintain the system balanced configuration.

3.1.4 Testing and Balancing Analysis Report

3.1.4.1 System Reports

Within thirty (30) days after the testing, balancing and adjusting of a system is complete, the Seller shall submit to the Buyer completed system report. The report shall be as follows:

3.1.4.1.1 All report forms shall be as those prepared by AABC with the approval of the Buyer. All sheets and entries shall be neatly typed.

3.1.4.1.2 Size, type and manufacturer of all tested equipment shall be identified and listed in the report.

3.1.4.1.3 Each volume damper, valve, fire damper, grille, diffuser, and register shall be identified in the report as to location and area.

3.1.4.1.4 All data taken throughout the various phases of the test and balance work shall be recorded in the appropriate approved form. The data and information shall include the following as a minimum:

A. Air Quantities

1) CFM capacity of each system.
2) CFM at each grille, register, and diffusers.
3) CFM at each air handling units supply, return and fresh air.
4) CFM at each exhaust fan.

B. Air Temperatures

1) Outside air temperature.
2) Inlet and discharge temperatures, including wet bulb temperatures of all cooling coils and evap-cooler units.
3) Inlet and discharge temperatures of all heating coils.

C. Air pressure drop at all coils and filters.

D. Fan Data

1) Direct or V-belt drive.
2) Wheel type, size, and RPM.

E. Motor Data

1) RPM, amperage and voltage input to all motors.
2) Nameplate data.

F. Noise and Vibration

1) Measurement of equipment vibration level.
2) Measurement of equipment noise level at a distance of three (3) feet.

G. Discrepancies

Make note of any discrepancy between recorded parameters and specified parameters.

H. Adjustments

List all the adjustments made to all systems.

I. Balancing Agency Staff

1) List name of the company, address, telephone and the names of the staff who worked on this contract.
2) Briefly describe the responsibility of each staff member.

3.1.4.1.5 Test instrument calibration data sheets in accordance with Paragraph 2.1.2B of this specification shall be submitted as part of the system analysis reports.

3.1.4.2 Final Report

After the final system balance is complete and all testing and balancing system analysis reports have been approved and accepted by the Buyer, the Seller shall deliver a final assembled report containing all test and balancing data and analysis.

3.2 **INSTALLATION, APPLICATION AND ERECTION**

(Not Used)

3.3 **FIELD QUALITY CONTROL**

3.3.1 Inspection and testing shall be performed as required by field inspection and checkout checklist (Attachment A).

3.4 **ADJUSTMENTS**

(Not Used)

3.5 **CLEANING**

(Not Used)

3.6 **PROTECTION**

(Not Used)

3.7 **DEMONSTRATION**

(Not Used)

3.8 **SCHEDULES**

(Not Used)

END OF SECTION

ATTACHMENT A
FIELD INSPECTION AND CHECKOUT CHECKLIST

HVAC SYSTEM TESTING AND BALANCING

Equipment Number _____ Purchase Order No. _____

Location _____

Installed By _____ Mfr. _____

Specification No. _____ Rev. ___ Dwg. No. _____ Rev. ___

NOTES:
1) This checklist covers the general requirements for the inspection and testing of equipment for start-up. It should be used in conjunction with the manufacturer's installation, testing and operating instructions.
2) All test equipment and instrumentation shall be properly calibrated per manufacturer's instructions. Items out of calibration or damaged shall not be used for testing.
3) Record all defects, missing parts, etc., and action taken to correct.

Items to Inspect/Check/Test	Installation Meets Requirements Signature	Recorded Data Remarks
(Inspection/check/test procedures to be detailed in this section. Items should be listed in the order to be accomplished.)		

PROCEDURE APPROVAL — SELLER REPRESENTATIVE _____ DATE _____
BUYER'S REPRESENTATIVE _____ DATE _____

TEST COMPLETION ACKNOWLEDGEMENT — SELLER REPRESENTATIVE _____ DATE _____
BUYER'S REPRESENTATIVE _____ DATE _____